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ELEMENTARY LESSONS IN HORTICULTURE.

BY PROFESSOR J. R. GREEN, M.A.,
Late Examiner in Botany to the University of Cambridge, and
F. L. GREEN,
Late Science Mistress in the Clifton High School.

VI.—THE FLOWER AND ITS FUNCTIONS: HYBRIDIZATION.

IN considering the nature of the flower it will not be difficult to assure ourselves that we have before us a modified shoot. We will choose for inspection a buttercup. Let us first make a longitudinal section of the flower, cutting it lengthways through the *peduncle* or flower-stalk. We shall then see that the top of the peduncle forms a conical body, the *receptacle*, which derives its name from the fact that on it are placed, or received, the floral leaves. The receptacle is the shoot axis on which are crowded, by the non-development of internodes, the modified leaves forming the flower. Beginning at the outside, we can pick off five small yellowish green *sepals*, composing the *calyx*, which plainly exhibit a leafy character. As easily classed with leaves is the next whorl of organs, the bright yellow *petals*, forming the *corolla*. We come, then, to a number of yellow threads, the *stamens*, making up the *androecium*, in which we shall not at first see much resemblance to leaves. Let us look at them more closely. We can distinguish a thin stalk or *filament*, and a thickened part, the *anther*, from which, when ripe, there escapes a yellow dust called *pollen*, which will be considered more fully later. That stamens are modified leaves may be shown by the examination of a water lily in which some of the stamens may be seen reverting to petals. Inside the androecium are a number of small green bodies, the *carpels*, forming the *gynoecium* or *pistil*. They are the seed-bearing organs of the plant, and may be regarded as folded leaves. The reversion of a pistil directly to a leaf may be seen in the double-flowering cherry of our gardens.

We have now to make a distinction between the four series of floral organs we have found to be present in the buttercup. The flower is the organ of the plant by which the continuance of the species is assured by the production of seeds, each of which, as we have already seen in our consideration of the process of germination, may be regarded as a rudimentary resting plant, together with the reserve material necessary for the resumption of active life under the influences of moisture, air, and warmth. To this reproductive function the androecium and the gynoecium are alone essential, the outer floral organs, the calyx and corolla, not always being present, and when existent, serving, as we shall see, auxiliary functions. In other words, the stamens and carpels are the essential organs of the flower.

We may now define the calyx as the outer set of floral envelopes. It is generally more herbaceous in character than the corolla, but in some cases, as in the fuchsia, it is highly coloured. Often, as in the case of the rose, it is persistent, lasting during the ripening of the seeds. Sometimes it falls off, however, before the corolla, as in the case of the poppy. The corolla is the inner set of floral envelopes, and is usually the most showy part of the flower. Many plants, such as the iris, crocus, and tulip, have apparently only one floral envelope, to which is generally given the name of *perianth*. This is really composed of both calyx and corolla. As regards their structure, petals and petaloid sepals will be found to have on either side a delicate epidermis. Internally are one or more layers of spongy parenchyma, the veined appearance of the leaf being due to the delicate vascular bundles which traverse it. The colours of flowers are due to pigments contained in the epidermal cells. Blue and red are found to occur dissolved in the cell sap, while yellow and orange are generally contained in variously shaped colour bodies. A large number may be seen in each epidermal cell of the garden nasturtium, or Indian-cress.

Let us now examine the androecium of our buttercup. Each stamen will be seen to consist of a stalk, or filament, and a thickened head or *anther*, containing the yellow dust, *pollen*, which when ripe is liberated by the dehiscence or opening of the anther. The filament may be very short or absent, as in the

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primrose, but the anther is always present. Generally each lobe of the anther splits longitudinally to release the pollen, but in a few cases, as in the potato and heath, a pore or minute fissure is formed at the tip of each lobe. In the barberry we meet with valvular dehiscence, part of the wall in each lobe forming a kind of flap which remains united to the tip of the anther. As regards their structure, the exterior of stamens is covered with epidermis, beneath which is ground tissue or parenchyma. The filament and its continuation, the *connective*, which separates the anther lobes, are traversed by a central vascular bundle. Each lobe contains one, or sometimes two pollen sacs enclosing pollen, a fine, sticky, dry powder composed of a great number of pollen grains. Several grains are found united together in heaths and rhododendrons, and in orchids the whole of the pollen in each lobe of the anther is united into a club-shaped mass called a *pollinium*. Pollen grains are formed by the active division of parenchymatous cells of the ground tissue. After the party wall between the two sacs in each anther lobe breaks down, their contents escape to the exterior by the formation of a slit. In form pollen grains are mostly spherical. They have two membranes, a firm outer one called the *extine*, and a delicate inner one known as the *intine*. Inside the intine in the buttercup and other angiosperms is a single cell containing protoplasm in which are embedded two nuclei.

We will now briefly consider the character of the pistil or gynoecium, reserving a more detailed discussion of this organ till we come to the consideration of the fruit. In the buttercup we have a number of separate carpels, each of which may be regarded as a folded leaf, the thickened edges of which bear an ovule or rudimentary seed, and are united into a seam called the *ventral suture*. The other edge of the carpel corresponding to the midrib of a foliage leaf is called the *dorsal suture*. Each carpel will be seen to possess its own ovary, or seed-containing organ; its own *style*, or middle part, which in the buttercup is a short beak, and its own *stigma*, or small sticky summit. If we now compare with the buttercup the pistil of the poppy, we shall see that instead of several free carpels we have a whorl of carpels united into one pistil. There is, then, but one seed-containing organ or ovary. Deferring for a time the consideration of the arrangement of the ovules in the ovary, as coming more properly into our discussion of the fruit, we may say that the wall of a carpel consists of two layers of epidermis, enclosing parenchymatous ground tissue through which run numerous vascular bundles. The centre of the style is generally occupied by a very delicate loose conducting tissue, as in the fuchsia, but in some flowers, *e.g.*, the lily and hyacinth, the style has traversing it a pollen-canal. The ovule may be more readily examined in the pea or bean than in the buttercup. If a pod of either of these plants be examined, it will be seen that the unripe seeds are ovoid bodies with a free *apex*, and a *base* attached to the *placenta*—as the part of a carpel to which ovules are attached is termed—by a slender stalk called the *funicle*. Near the edge of a young carpellary leaf there first occurs a small conical protuberance called the *nucellus*. Soon after the formation of this body, the cells at its base, by the processes of division and growth, invest it with a cup-like integument around which another is formed in a similar manner. The two integuments do not, however, completely enwrap the nucellus; a narrow channel, the *micropyle*, being left, and forming a passage from the apex of the nucellus to the cavity of the ovary. In the majority of cases a greater growth occurs on one side of the ovule than the other, thus turning that body completely round and bringing the opening of the micropyle close to the wall of the ovary. During the growth of the ovule, there is formed in the nucellus, near the micropyle, a large cell, differing at first from the other cells only in point of size. This is known as the embryo-sac. By a curious and interesting process of repeated division of its nucleus, it ultimately contains, at its upper end, three naked masses of protoplasm, each with a nucleus. Of these three one is especially important, as it develops later into the embryo, or young plant. At the time the ovule is mature it is known as the *oosphere* or *egg-cell*.

We are now in a position to examine the functions of the flower, or the reasons for calling it an organ of reproduction; for reproduction in flowering plants is chiefly the process of production of seeds. For this the agency of the pollen grains of the androecium and the oospheres of the gynœcium are alone necessary; the calyx and corolla, when present, serving merely auxiliary functions. The pollen grain having by various agencies, which we shall presently allude to in more detail, been placed on the stigma or sticky part of the pistil, it germinates. The outer cell-wall having burst, the inner one grows out, forming a protuberance which soon becomes a tube developed down the style to the cavity of the ovary in the direction of the micropyle of one of the ovules. At the end of the pollen-tube a nucleus is present, and when the tube reaches the embryo-sac, its nucleus passes through the thin cell-wall of the end of the pollen-tube, and fuses with the nucleus of the oosphere. A single cell is thus formed, which is called the *oospore*, and from its repeated division a new plant is eventually formed. To the placing of the pollen-grain upon the stigma we give the name of *pollination;* to the fusion of the nucleus at the end of the pollen-tube with the nucleus of the oosphere that of *fertilization*.

On comparing the modes of fertilization presented to us by garden plants, we shall see that, though in the majority of instances the organs of reproduction—the stamens and carpels—are borne in the same flower, in many instances the stamens and pistil, though borne on the same plant, occur in different flowers, and in some cases they are borne on separate plants of the same species. A flower in which both series of organs are present is said to be *hermaphrodite*. The second kind of arrangement—instances of which are furnished by the fir, oak, beech, and arum—receives the name of *monœcious*, while the third, found in the hemp, hop, etc., is called *dioecious*. Occasionally, as in the ash and maple, we meet with unisexual and bisexual flowers in the some plant. Such plants are said to be *polygamous*. We have seen then, that the sexes may be separated by distance. They may also be separated by time, the stigma and anthers rarely developing simultaneously.

Where one set of organs is mature before the other, we have what is called *dichogamy*. This phenomenon

may assume two forms. In the common plantain, which forms such a troublesome weed in lawns, we have a good example of the first, which is called *protogyny*, the stigma being mature in each flower before the anthers are ripe. If a spike of plantain be gathered, it will be seen that the styles, with their stigmas, protrude from the flowers. They are mature and ready for fertilization, but neither stamens nor anthers are to be seen. On the other hand, towards the base of the spike the styles are withered and useless, though the long filaments still expose their conspicuous anthers. A directly opposite state of affairs may be seen on examining the flowers of a common garden weed, the gout-weed, or those of the carrot or parsnip. The filaments in the young flower will be seen to be curled inwards, the anthers being thus, as it were, tucked into the centre of the flower. The filaments uncurl one after another as the anthers ripen, and the last anthers are emptied and withered before the stigmas are fit for pollination. Where the anthers are ripe in the flower before the stigmas are mature, we have what is called *protandry*.

We have now to consider the reason of the separation of the sexes which we have observed to occur in plants—a separation by distance and a separation by time. They are both caused by the operation of a principle which may be thus enunciated. 'While *cross-fertilization* is beneficial, *self-fertilization* is generally less so, the offspring of the former having been proved by experiment to be more vigorous and healthy than the offspring of the latter.' Let us examine this statement a little more in detail. Self-fertilization takes place where the anther and carpel concerned are part of one flower, cross-fertilization when the organs concerned in reproduction are borne on separate plants, or when the anther and carpel concerned belong to separate flowers on the same plant. It follows that in dioecious plants cross-fertilization must result, while in hermaphrodite flowers, self-fertilization will probably ensue in the absence of dichogamy and various floral mechanisms designed to bring about cross-fertilization.

We may regard cross-fertilization then, as most to be desired by the plant, since, if of two flowers growing on one plant the one is self-fertilized and the other receives pollen from another plant, the seedlings from the former will certainly be less healthy and vigorous than those from the latter. It must be borne in mind, however, that self-fertilization is better than no fertilization, and that cross-fertilization and certainty of fertilization are to some extent incompatible. In dioecious plants, should the agency designed to carry the pollen fail, or the plants grow in too isolated a way to ensure regular fertilization, sterility results. On the other hand, the flowers which are the most absolutely sure of becoming fertilized are incapable of cross fertilization. A good example is presented by the dog-violet—*Viola canina*. Besides its conspicuous flowers, this plant bears minute bud-like structures, the *cleistogamous* flowers, which never open. In them the pollen, never being exposed, cannot be spoilt by rain. Moreover, no agency is required to carry it to the stigma. The anthers are close to the stigma, the pollen-grains germinate inside the anther, and the pollen-tubes grow thence directly to the surface of the stigma. Between dioecious plants which can only be cross-fertilized, and cleistogamic flowers which must be self-fertilized, there are many intermediate arrangements which have for their object the making fertilization reasonably sure without losing all prospect of cross-fertilization. The principle of *prepotency* may be mentioned in this connection. In virtue of this principle, when a stigma covered with pollen from its own flower afterwards receives pollen from another individual, even after the lapse of several hours, the latter is *prepotent* over the first, superseding its action. Cross-fertilization thus annuls self-fertilization. It should be noticed, too, that some plants are *self-sterile*, *e.g.*, some species of Passion-flower, the pollen in the anthers surrounding, and even covering, the stigma being wholly ineffectual for fertilization, while pollen from any other individual is effective. Such plants, if fertilized at all, are cross-fertilized.

We have now to consider the agencies by which pollen is conveyed from flower to flower, a process we have found to be necessary in the case of dioecious plants and desirable in other cases. Pollen may be distributed in three ways—by floating in water, by floating in air, and through the medium of animals. Aquatic fertilization is called *hydrophily*, and may be neglected in this connection. The other two classes —*anemophily*, or wind distribution, and *zoophily*, animal distribution—are of great importance.

The pollen of *anemophilous* plants possess certain marked characteristics of a positive character. In the first place, such plants produce an enormous quantity of pollen, because, as it is sown broadcast by the wind, a large quantity must necessarily be wasted. Whether a grain reaches the stigma of its own species is a matter of chance, and the greater the number of grains produced the greater is its chance of doing so. So largely is pollen distributed in the air that it has been held to be one of the causes of hay fever. In the second place, *anemophilous* pollen will be seen to be dry in character, the grains consequently separating easily from one another, and floating readily. Thirdly, there is a tendency among anemophilous plants to the development of arrangements favouring the dispersal of their pollen. They are generally tall, as in the case of trees and shrubs —firs, oak, hazel, juniper, etc.—and where they are of lowlier habit, *e.g.*, grasses, sedges, and plantain, the flowers are more or less raised up on the stem. Another adaptation to the end of easy distribution is the curious winged pollen found in some firs. Here the outer coating or extine of the grain develop blisters which become filled with air and help to float the grain. In some cases, *e.g.*, the grasses and plantains, long pendent stamens occur with anthers that swing freely about, from which the pollen is easily shaken out by the wind. Frequently we meet with *catkins*, where the filaments are short, as in the oak, hazel, and chestnut, *i.e.*, the male flowers are collected on a pendent flexible spike which vibrates in the wind, thus shaking out their pollen. In these trees also the flowers are developed before the leaves, thus favouring the dispersion of the pollen and increasing the chance of its reaching the stigma. In very many anemophilous plants, not only is the stigmatic part large, but very large stigmatic projections are formed at the surface.

It is interesting to notice in a little more detail the flower of the grass. There we find the stamens and pistil enclosed and protected by enveloping

scaly leaves. A large quantity of pollen is produced by the three stamens, and the very slender filaments, as they increase in length, push the anthers outside the scales, allowing the pollen hitherto protected to be blown away. The two feathery stigmas which spring from the top of the ovary readily catch the pollen grains.

Passing now to the negative characters possessed by wind-pollinated plants, we have first to notice the simple structure of the flower, and then its general want of bright colour. Some anemophilous flowers are, however, conspicuous, *e.g.*, the catkins of the hazel and the brightly-coloured female flowers of the sorrel. Large flowers would tend to prevent the free distribution of the pollen by the wind, and brilliant hues in common with scent and nectar are generally absent in wind-pollinated plants, not being required.

We may now proceed to investigate animal-pollinated or *zoophilous* plants. Though birds and snails, in the case of some tropical plants, have been found to act as pollen distributors, we may, for our purpose, confine ourselves to the consideration of plants fertilized through the agency of insects, and in consequence termed *entomophilous*.

Before examining any of these plants in detail, we may briefly describe the advantages of insect-pollination as coming under four heads: (i.) a greater economy of pollen than is possible in the case of wind-pollinated plants; (ii.) the power gained by the flower of controlling the action of its insect visitors by what may be termed bribes held out to them, or difficulties placed in their way; (iii.) the habit shown by bees of visiting steadily, one after another, a number of individuals of the same species; a habit tending to prevent the waste of pollen and failure of fertilization consequent on the pollen of one species being placed on the stigma of another; (iv.) the security of the pollen from rain by the flower being so contrived that at the same time it keeps out the rain and admits the insect.

With regard to the economy of pollen consequent on insect-pollination, it has been seen that a large proportion of pollen must inevitably be wasted in wind-pollination. On the other hand, many flowers are visited by a very limited circle of insects, and if these fail, through the inclemency of the season or otherwise, fertilization is endangered. In some of our colonies red clover sets no seed, owing to the absence of humble-bees, its usual pollinating agents.

Conspicuousness, scent, and food supplies—mainly a sweet secretion called nectar and pollen—are the chief attractions offered by flowers to insects. The corolla, a cursory examination of the garden will show us, is usually coloured; the calyx is often coloured, as in the fuchsia, lily, and tulip. In the arum of our greenhouses the enlarged *spathe*, or sheath-like *bract*, supplies the needful quality of conspicuousness. It is interesting to note that insects show preference with respect to colour. Bright yellow seems to have a strong attraction for certain beetles and flies. White, in many cases, attracts night-flying insects, white flowers being at night especially conspicuous. Purple and blue flowers are preferred by bees, and wasps are found to often visit reddish-brown blossoms. In some plants, as in the parsnip, conspicuousness is secured by the flowers—in themselves insignificant—being aggregated into clusters.

Odour is a more powerful attraction to insects than bright colour; the sweet-scented violet, for example, being more visited than its brightly-coloured but scentless congener, the pansy. Fragrant flowers are found to attract the higher insects, such as bees, butterflies, and moths; while in some cases fœtid odours are given out to attract carrion flies. Some flowers, *e.g.*, the night-scented stock, reserve their fragrance till this season in consequence of their being pollinated by night-flying insects.

Nectar is a watery fluid containing sugar in solution, which is excreted by glandular organs called nectaries. A nectary consists of a group of glandular cells situated in close relation to the terminations of one or more fibro-vascular bundles. Its position in the flower varies, but is usually such, that when an insect visits the flower, it must, in order to reach the nectary, come in contact with the anthers and carry off some of their pollen, and that when the insect visits another flower of the same species, the pollen, adherent to its body, must be rubbed off on the stigma of the latter flower. Sometimes nectaries are found at the base of the petals, as in the buttercup; sometimes they occur as glands between the stamens, as in the grape-vine; sometimes they form a fleshy honey-secreting cushion on the top of inferior ovaries, as in the parsnip and daisy. Nectar constitutes the most powerful attraction for insects, and, as we shall presently see, it is specially protected.

Pollen is rich in protoplasm and very nutritious. It therefore forms the chief food of many insects, and many flowers, *e.g.*, the wood anemone and the common field-poppy are actually fertilized by these insects visiting them for the sake of their pollen. Like nectar, it is specially protected. A third food-material which encourages the visits of insects, is the sap included within succulent tissues. Many flies, the more specialised bees and butterflies, are provided with a boring apparatus at the tip of their proboscides, and the inner membrane of the spur of English orchids is often pierced by insects, though from the comparatively few visits these plants receive, it may be concluded that sap is less attactive to insects than nectar and pollen.

Lastly, it may be observed that the shelter many flowers afford from wind and rain operates as an attraction to insects. The males of many bees have been observed to shelter themselves from rain or pass the night within the bell-shaped flowers of campanulas, and many small flies resort for shelter to the flowers of the arum.

We have now to discuss the difficulties placed in the way of insect visitors and the control thus exercised over their visits by flowers. Most flowers secrete volatile oils which are distasteful to caterpillars, and dull-yellow flowers are almost wholly avoided by beetles. We have already noticed that the stem often acts as a means of protection—spines, thorns, and prickles, when closely set, repelling the attacks of snails and slugs—and viscid substances exuded by the stem preventing wingless insects from reaching the leaves and flowers. Wingless insects, too, are most active when the dew is evaporated, and evaporation is, in many cases, a signal for the closing of the flower. The development of extra-floral nectaries on the stipules of beans and at the base of the leaf-stalk of the almond and peach serves to divert unwelcome insects from the blossoms.

Absence of honey and the inaccessibility of the honey or pollen are, however, the chief means of restricting insect visits. Honeyless flowers with anthers projecting from the corolla are scarcely visited except by pollen-feeding flies and pollen-collecting bees. When in such flowers the production of pollen and the conspicuousness of the blossoms is not great, as in the potato-blossom, insect-visits are so infrequent that the species is only preserved by the regular occurrence of self-fertilization. The concealment of the honey in a nectary protected by other parts of the flower-hairs or processes, or which assumes the shape of a spur, brings two advantages in its train. In the first place, the honey is protected from rain; in the second, a large supply is accumulated and an increased number of visitors is attracted. It is true, however, that two apparent disadvantages are thus entailed. Firstly, the honey being the more effectually protected from rain a great number of less intelligent insects are excluded from it, but the exclusion of the host of less acute, short-lipped visitors is really not injurious, being more than counterbalanced by the increase of long-tongued visitors consequent on the larger accumulation of honey resulting from the development of special structures containing and protecting the honey. A second objection, the delay in the work of fertilization caused by concealment of the honey is more specious, but a variety of contrivances, in many cases modifying the structure of the flower, alleviates and often removes this delay. In the petals of pelargoniums and the lower lips of the monkey-flower there are coloured spots or lines which point towards the honey, thus guiding the more intelligent insects. In the fox-glove the lower lip forms a convenient landing-stage, thus saving time. Apertures, especially fitted for the insect's head or proboscis, occur in two-lipped corollas, and many flowers, *e.g.*, thyme and mint, are grouped together closely so as to admit of a rapid passage from flower to flower.

A very interesting example of insect-selection is afforded by the natural order *Ranunculaceae*, the crow-foot tribe. In the hepatica of our gardens we have simple open flowers, destitute of nectar, and visited only for their pollen. In the buttercup, nectar exists indeed, but it is very slightly protected, and is consequently resorted to by a number of insects with short trunks. The columbine has tubular petals, with a cup-shaped mouth, wide enough to admit the head of a humble-bee, and a narrow, curved, tubular part containing honey, which is explored by the bee's proboscis. In the monkshood the two posterior petals are modified into such long-stalked nectaries that only bees with a very long proboscis can obtain the nectar.

We will now consider the protection of nectar and pollen from rain. A very slight and simple adaptation of the flower seems, in the former case, to be sufficient for protection. In the strawberry the nectar is in a valley between the stamens and carpels; in the meadow crane's-bill it is secreted by glands at the bases of the outer stamens, and protected from rain by hairs at the bases of the petals. Tubular corollas vary in length from the short tube of the forget-me-not to the long tube of the honeysuckle, and vary consequently in efficiency. How is this, together with the elaborate construction of some nectaries, to be accounted for? The answer is to be found in the plant's selection of insect-visitors. The nectar of a simple open flower, unprotected from rain, is accessible to all kinds of insects. Where we have a simple protection, such as the presence of hairs or a short corolla tube, fewer insects are admitted, and in highly modified cases, such as larkspur and columbine, all but a very narrow class of visitors are excluded. Many flowers are specially constructed for the admission of bees, other visitors being excluded by difficulties placed in their way. Thus the entrance to the flower of the snapdragon is so firmly closed that even small bees are excluded in favour of the large humble-bee. Again, only humble-bees can fertilize the foxglove, our other insects being too small to touch the stigma and anthers with their backs when creeping into the tube of the corolla; and hanging flowers, such as the heaths, are almost entirely fertilized by bees, this class of insects being accustomed to work in various and difficult attitudes. The exclusion of other visitors makes such flowers more attractive to bees, since they are, in consequence, more likely to find nectar, and, since bees are the quickest of fertilizers, far more flowers are fertilized in a day by a bee than by a fly or butterfly.

In many cases both pollen and nectar are protected by the same agency. The reversed corolla of hanging flowers roofing both of these substances, and the closed flowers of the toad-flax are cases in point. The concealment of the pollen in a conical ring of anthers, as in the violet, prevents its being devoured by flies and beetles, and honey-seeking bees cannot reach the nectar without causing the cone to open and shed its pollen on them. When the tube containing the stamens is closed, as in the snapdragon, speaking generally, only bees can obtain either honey or pollen. Where the anthers are protected from rain by enclosure in a lip, as in the dead nettle, beetles cannot obtain the pollen, a few intelligent flies and bees acting as insect-visitors. The pollen is most thoroughly protected when the stamens are completely shut up within the corolla, as in the pea and sage. A common mode of protection is found in the periodic closure of flowers. Many flowers, such as the crocus and tulip, are very sensitive to slight changes in temperature, while others are more sensitive to light than to heat. In both cases the flower closes on dark, cold, rainy days, thus saving its pollen for bright, warm days on which the bees are about.

It is obvious that insect-visits are limited by the time of flowering and the place of growth or *habitat* of flowers. Only those insects which occur at the time when the plant is in flower and in the places where it grows, are capable of visiting and fertilizing it.

We may now briefly consider some of the structural characters which aid in fertilization. In the first place, there are a large number of species in which the pollen is presented to the insect through the agency of the style. A good example is afforded by the Canterbury-bell. This is a *protandrous* flower. The anthers shed their pollen before the flower opens, and a great deal of it adheres to the hairy outer surface of the style and is carried to older flowers, in which the lobes terminating the style are expanded, exposing their stigmatic inner surfaces. In the sunflower, the style of the inner or disc florets has a little brush of hairs at the end which sweeps the pollen out of the tube and afterwards spreads

into two lobes, which, on expansion, display their stigmatic inner surfaces. In the broom we have an instance of exploding mechanism. The style has a strong tendency to curve upwards, but is prevented from doing so by being confined within the keel. An insect visiting the flower by its weight ruptures the keel; the style, thus released, curves violently upwards and bends itself into a circle, striking the visitor on the back with its stigmatic surface and jerking into the air the pollen, some of which falls upon the insect. In the vetch the pollen is shed into the hollow of the keel, and the style possesses specialised tufts of hair which act as pollen-brushes, transferring the pollen to the visitor when the style emerges on the depression of the keel by the insect.

Another interesting instance of floral mechanism occurs in the case of loose pollen—a good example to observe being the snowdrop. The free extremities of the anthers curve slightly outwards, the tips being thus liable to be touched by the bee as he hangs on at the mouth of the corolla and probes the nectar-grooves. The pollen thus shaken out falls on the bee, who carries it to another flower, and as the stigma in the snowdrop projects enough to be touched by the visitor, cross-fertilization is rendered likely.

In the third place we may notice the mechanism presented by trap flowers, an example of which is afforded by the plant popularly called 'lords and ladies.' Small flies, attracted by the nectar secreted by the withered stigmas, creep down till they reach the cavity formed by the lower part of the spathe. There they are imprisoned by several rows of hairs (metamorphosed stamens) which point downwards, forming a palisade. The pollen from the anthers collects at the bottom of the cavity, and, when the flies escape on the withering of the palisade hairs, they carry the pollen to flowers in an earlier stage of development in which the stigmas have not withered.

It remains to notice that in all generally accessible entomophilous flowers, the pollen, instead of being dry and dusty, as in anemophilous plants, is rough or viscid, adhering readily to the usually hairy surfaces of insects.

We have hitherto been discussing the fertilization of plants of the same species or variety. In hybridization, the fertilization taking place between two different species, we have a topic of special interest to horticulturists, for innumerable hybrids adorn our gardens, and are being added to every year. We may note (i.) Only nearly allied plants can form hybrids with each other, hybridization being effected most completely and easily between different varieties of the same species; (ii.) Plants that are externally very similar, are often incapable of hybridization, *e.g.*, the apple and pear; (iii.) The hybrid exhibits a fusion of the characters possessed by its parents, and also generally possesses new characters distinguishing it from both of its parent forms. Hybrids have a tendency to greater longevity than the parent forms, they flower sooner, longer, and more copiously, producing sometimes extremely large number of flowers which are larger, better scented, more intense in colour, and more persistent. Moreover, the flowers of hybrids have a tendency to become double, their capillary and staminal leaves being multiplied and developed as petals.

To recapitulate—we see that:—

(i.) The flower is a shoot modified for the purpose of reproduction, the essential organs of which are the stamens (androecium), and carpels (gynoecium), the pollen grains of the androecium and the oospheres of the gynoecium being the necessary agents of the process.

(ii.) Pollination is effected by the placing of the pollen grain upon the stigma; fertilization by the fusion of the nucleus at the end of the pollen tube with the nucleus of the oosphere.

(iii.) The sexes in plants are frequently separated by distance, plants in this connection forming four classes—(1) hermaphrodite, possessing both series of organs in the same flower; (2) monoecious, having the stamens and pistils in different flowers on the same plant; (3) dioecious, having the stamens and pistils borne on separate plants of the same species; (4) polygamous, with unisexual and bisexual flowers on the same plant.

(iv.) The sexes in plants are frequently separated by time (dichogamy), the stigmas being mature before the the anthers (protogyny), or the anthers being mature before the stigmas (protandry).

(v.) The sexes are separated by distance or by time to encourage cross-fertilization, the fertilization by pollen from another flower, a process found to result in more healthy and vigorous seedlings than self-fertilization, the fertilization by pollen from the same flower.

(vi.) Cross-fertilization is also promoted by the operation of the principles of prepotency and self-sterility. Some plants are only capable of self-fertilization.

(vii.) Pollen may be distributed from flower to flower by floating in water (hydrophily) floating in air (anemophily), or through the medium of animals (zoophily).

(viii.) In anemophilous plants the pollen is produced in great quantities, and is dry and capable of floating easily, while arrangements (*e.g.*, catkins) are developed, favouring its dispersal. The flowers are generally simple in their construction and inconspicuous.

(ix.) Entomophilous, or insect-fertilized plants in England practically represent zoophilous plants. Such plants offer as attractions to their visitors conspicuousness, scent, food-supplies—nectar, pollen, and sap—and shelter. Control over insect-visitors is effected chiefly by absence of honey, and by the inaccessibility of honey or pollen. The exclusion of certain classes of visitors makes the flower more attractive to a narrower circle. Economy of pollen follows from insect-pollination.

(x.) Certain structural characters—the presentation of the pollen to the insect by the style, loose pollen, trap-flowers—are effective aids to cross-fertilization.

(xi.) Hybridization, the fertilization which takes place between the different species, has produced most of our garden flowers, vines, etc. Hybrids exhibit a fusion of the characters of their parents, and also characters distinguishing them from their parents.

(xii.) While the main function of the flower, as we have seen, is reproduction, respiration, a function discussed under the heading of the leaf, is imperatively necessary for its maintenance.

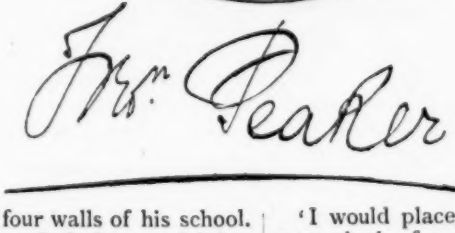
COMING MEN.

V.—MR. F. PEAKER.

Member of the N.U.T. Executive; Member of the Committee of the National Federation of Assistant Teachers.

To interview Mr. F. Peaker it was necessary to make a journey to Leeds. The reminiscences of the '92 N.U.T. Conference still lingered with me, and it was with the knowledge that a hearty Yorkshire welcome would be given me that I travelled thither.

Mr. Peaker lives at 6, Linden Road, and I received the cordial greeting which I had anticipated. On getting to business I discovered that Mr. Peaker was born in Leeds in 1866, was educated at the York Road Board School, and served his apprenticeship as a P.T. at the South Accommodation Road Board School. In 1885 he entered York Training College, and both in that year and in '86 he was placed in the First Division on the Certificate List. It is noteworthy that Mr. Peaker has always retained an intense interest in his *alma mater*. He annually gives a prize to the students of the First Year for English, and he is at the present time the Treasurer of the York Club. On leaving college he returned to Leeds, and was appointed to the Hunslet Carr Board School as Assistant Master, which position he still retains. Mr. Peaker is a young man whom it would be almost impossible to keep out of public life. His home surroundings, his natural inclination, his evident grasp of public questions, all serve to convince one that his little world could not be limited to the inside of the four walls of his school. Hence it is not surprising to find that on joining the Leeds branch of the N.U.T. in 1887 he commenced to make his influence felt, and in the following year was elected to the Committee. In 1889-90 Mr. Peaker was the General Secretary, and in 1891 Joint Secretary, to this important association.



He has represented his association at the Birmingham, London, Cardiff, Leeds, and Liverpool Conferences of the N.U.T. In 1890 the West Lambeth Teachers' Association conceived the praiseworthy idea of nominating a provincial assistant as a candidate for the N.U.T. Executive, and invited Mr. Peaker to address them. He was enthusiastically adopted as the candidate, and on going to the poll he was placed 25th on the list, being the highest unsuccessful candidate. The year 1891 will be remembered by the members of the Union on account of the loss sustained by the demise of several valuable members of the Executive, and it was owing to these circumstances that Mr. Peaker found himself in June of that year co-opted as a Member of the Executive, and he took his seat with the distinguished honour of being the first provincial assistant teacher to secure a position at the Executive Board. Seeking re-election in 1892, Mr. Peaker was placed tenth on the list, and in 1893 a further evidence of his popularity was revealed when his position was found to be sixth on the list of successful Executive candidates. If the position of the Assistant Teacher at Russell Square depended upon the opinions formed of the first *bonâ fide* assistant sent there, we may rest assured that his position is a good one. Some idea of the opinions held by our subject may be gathered from his maiden speech in the Executive, when he moved that an interchange of deputations between the Conference of the N.U.T. and the Co-operative Congress should be established. Mr. Peaker was defeated by a majority of one, and he gave me to understand that he had again placed his resolution on the agenda of the present Executive. He takes a great interest in the Co-operative movement, and was nominated this year by the Leeds Society as a delegate to the Congress, but was obliged to decline to stand. His policy on the Executive of our Union has always been of a high educational order.

'I would place,' says he, 'Education as the foremost plank of our platform, and after that the Educator.' Mr. Peaker is the Vice-Chairman of the Technical and Secondary Education Committee of the N.U.T. To most of our readers Mr. Peaker will be familiar, owing to his efforts at the Leeds and Liverpool Conferences. His speech at Leeds should not be forgotten. It conveys a salutary lesson to many members of Conference. Replying at the fag end of the closing session to a vote of thanks, he said,

'We have done what we could. We have been appreciated. We are accordingly thankful.'

The lesson needs no demonstration.

But undoubtedly Mr. Peaker's masterpiece of eloquence up to the present time was his remarkably able and argumentative effort on the question of Electoral Districts at Liverpool, and the fact that the promoters of that scheme were defeated as substantially as they were, was in no small degree owing to the convictions which Mr. Peaker brought to the minds of the assembled representatives.

In the direction of improving the status and redressing the grievances of the Assistant Teacher he has ever laboured. When the Leeds Trained Certificated Assistant Teachers' Association was formed in 1890, Mr. Peaker became its first President. When the first Conference of Assistant Teachers was held at Sheffield he was present, and also at every subsequent Conference.

In connection with these gatherings Mr. Peaker has been conspicuous by his stern, unflinching opposition to the proposal to federate the Assistant Teachers' Association.

In reply to a query upon the cause for this opposition, he said,

'I am by inclination and training a National Unionist, and I am extremely loth to countenance any movement which may tend in any degree to be opposed to the interests of our Union. The supremacy of the Union is to me of great importance, and in connection with Federation my position may be summed up in the fact that I am first a National Unionist and then an Assistant Teacher.'

Asked what his attitude would be now that Federation was an accomplished fact, he said,

'I conceive it to be my duty to support the Federation, and endeavour to the best of my ability to make the organization a sub-section of the N.U.T.'

Mr. Peaker, it will be remembered, was elected to the Assistant Teachers' National Committee at the Nottingham Conference in 1892, and at the Derby Conference of '93 he was elected a member of the Committee of the National Federation of Assistant Teachers. In addition to these offices Mr. Peaker is a member of the Executive of the West Yorkshire District Union. He is also a life member of both the N.U.T. Orphan and Benevolent Funds, as well as of the Church Teachers' Orphanage Fund. In the Leeds Debating Society, which is noted for the skill of its members and its high standard of debate, he holds the office of Minister of Education.

Such, then, is the position occupied by this young man of twenty-seven summers.

The true stamp of the educationist characterises him, as this brief sketch has shown.

Having the advantage of some years' intimate acquaintance with Mr. Peaker, I cannot refrain from stating that I have always found him ever on the alert to advance the cause of Education, ever willing to utilise his great capacity for work for the benefit of his colleagues, possessing always the courage of his convictions, consistent in his advocacy of any line of policy which he has taken up, and as a natural consequence winning the esteem of all classes with whom he has been in contact. Surrounded by every inducement to refrain from voluntarily labouring for the betterment of his cause and his fellows, he is a striking example to the lethargic non-unionist teacher, whose interest in the cause of Education is measured by his neglect to accelerate the car of its progress.

NEW COMPOSITION STORIES.

STANDARD V.

Suitable for 'Unseen Tests' in Reading also.

131.

A Turkish Fable.—A King was hunting one day, when feeling hungry, he sat down to a slight meal. While he was eating, a bee came, seized a morsel of bread and flew away with it. Curious to see what it would do, the King followed the bee, which ultimately stopped at a bough of a tree on which was perched a blind sparrow. As soon as it heard the bees humming, the poor bird opened its beak, whereupon the insect broke the bread into three bits, fed the bird with them and then flew off. When the King beheld this wonderful work of Providence, he renounced all earthly ties, and devoted himself to the service of God.

132.

A Sagacious Burglar.—A married couple recently heard a noise under their bed in the middle of the

night. 'There is something under the bed,' said the man to his wife. 'Most likely it's the dog,' was the reply. 'But it might be a robber,' said the husband. 'Just put your hand under the bedstead,' was the wife's advice, 'If it's the dog he will lick your hand,' The man did as he was told, and the burglar, who had overheard the conversation, began at once to lick the proffered hand most assiduously. The couple then went off to sleep, but next morning they found little left that was worth carrying away.

133.

A Strange Decoration.—On the ceiling of one of the rooms in the palace once occupied by Frederick the Great, is painted a great spider with its web. The origin of this strage decoration is said to be as follows: This apartment was the great king's breakfast-room, and adjoined his bed-chamber. Every morning when his Majesty entered the room he was accustomed to find a cup of chocolate, but on one occasion, just as he was about to drink, he bethought himself of something he had forgotten and returned to his bedroom. When he again entered the breakfast-room his Majesty discovered that a great spider had, in the meantime, dropped from the ceiling into the cup, and he naturally cried out for fresh chocolate to be prepared. The next moment the king was startled by the report of a pistol. No sooner had the cook received the order than he blew out his brains—not because the king had refused the chocolate did he do this, but because he had poisoned the cup and had thought himself discovered. It was in remembrance of this narrow escape that his Majesty ordered the spider with its web to be painted on the ceiling.

134.

More Sentries, Fewer Oysters.—Several years ago the following incident occurred at Gibraltar. A Spaniard, the owner of an oyster bed, came up to the Mayor one day, and in an excited manner told him that every night for some considerable time a number of his oysters had been stolen, and asked him if he could not do something to prevent this continuous thieving. The Mayor said the only thing he could do was to place an extra sentry or two in the vicinity of his oyster bed and he did not doubt the thieves would be caught. Judge of his astonishment when the Spaniard, shaking his head in a most excited manner, exclaimed—'No, no, Mr. Mayor. No, no; more sentries more oysters go away.'

135.

Saved by a Spider.—A prince who had been defeated in battle fled for his life without a single follower, and hid himself in a cave in a wood. That night a spider wove his web across the mouth of the cave. In the morning, two soldiers from the enemy's army, detached in pursuit of the prince, passed the cave where he was lying. 'Look' said one, 'perhaps he is in that cave; it is a very likely place.' 'He can't be there,' said the other, 'for if he had gone in he would have brushed away that spider's web.' They went on without looking in, and the prince afterwards escaped. Thus, like Robert Bruce, a prince was indebted to a spider.

136.

The Dog's Revenge.—A farmer having sold a flock of sheep to a dealer, lent him his dog to drive them home, a distance of thirty miles, desiring the dealer to give the dog a meal at his journey's end, and tell it to go home. The drover found the dog so useful that he resolved to keep it; and instead of sending it back, locked it up. The dog grew sulky, and at last effected its escape. Evidently considering the drover had no more right to detain the sheep than he had to detain itself, the honest creature went into the field, collected all the sheep that had belonged to its master, and, to that person's intense astonishment, drove the whole flock home again.

137.

Catching Birds with Whiskey.—Large birds, such as the wood pigeon or plover, which generally keep to the open fields—and always at a respectful distance from any object that could conceal a man—are secured by Irish trappers, notwithstanding all their sharpness. This is the way it is done. The trapper invests in a bottle of whiskey, in which he steeps as much wheat as he requires for about twelve hours. This wheat he sprinkles thickly over that part of the field which the birds frequent. He knows to the hour what time they are due, and patiently awaits their arrival, hidden behind the hedge. When they arrive he gives them about fifteen minutes to gobble up the whisky-soddened grain, and then boldly walks towards them. On his approach there is a general rise, but some of the younger birds remain fluttering on the ground, and are soon captured.

138.

A Parrot Story.—A lady who had bought a parrot from a bird-fancier was shocked afterwards to discover that the parrot was addicted to bad habits. She at once took the bird back and complained, requesting the bird-fancier to refund her money. The man refused, saying it was quite easy to cure the parrot. He then told her, the next time the parrot offended to take it out of the cage, grasp it by the tail, and swing it violently round her head several times. It was not long before the parrot raised the lady's ire by a string of choice expressions, and she proceeded to 'take it out' of the bird. After swinging it round her head till she was tired, she laid the parrot on the table. The bird got up, and shaking his feathers together, quietly remarked:—'Good gracious, what a gale!'

NEW READING TESTS.—STANDARD III.

Suitable for 'Unseen Tests' in Dictation also.

109. Christmas boxes were at first what we now call money-boxes. They were known as thrift-boxes, and consisted of small wide clay bottles with imitation stoppers, the upper part covered with a kind of green glaze. On the side was a slit into which money could be put, and as the money was collected at Christmas the boxes in the course of time gave the name to the present.

110. A few years ago the native station-master of an out-of-the-way Indian railway-station was suddenly attacked by a tiger, made bold through hunger. The startled assistant immediately rushed to the telegraph office and wired to the European station-master at the next place on the line as follows: 'Tiger on platform eating station-master; please wire instructions.'

111. A farmer in Norfolk kept a number of geese, but one in particular, a gander, took a singular liking to him. On one occasion the goose accompanied him to market, and not making his appearance from the hotel where he had gone to dine as soon as the gander wished, the bird waddled upstairs in search of him, and caused much merriment by peeping into the dining room, and on seeing his master, giving vent to his joy by some high and not very musical notes.

112. A lady was watering her garden one day in early summer by means of a hose, when a little bird came under the shower for a bath. Presently she moved to another part of the garden, but the bird kept her company, standing on the gravel path whilst she watered it just as if it had been a flower, the water falling in a spray from the rose gently enough to do no harm to the mite.

113. The training to which a new member of the Fire Brigade has to submit is very severe. For one thing, he has to learn to rescue people. This is taught him in the following manner: A number of men go on to the roof of one of the buildings round the drill yard, and there arrange themselves in all sorts of curious attitudes, as if they had been overcome by the smoke.

114. Ducks are wild or tame. The wild ducks are either sea ducks or pond ducks. Their wings are long, reaching to the end of the tail, and they possess great powers of flight. The wild duck is found in almost all the temperate and arctic regions. These birds feed on fish, slugs, water-insects and plants, worms, &c.

115. My cat has a habit when she wants to get indoors of coming all the way down to the garden door, where I usually write, and mewing at my door. Of course I invite her in. 'No, no,' Pussy seems to say, 'that won't suit; you come this way and open the back kitchen door for me.' And away she trots in front of me with tail erect and loudly singing. And of course I follow her and do exactly as I am told.

116. A slug and a snail had a race
To the top of a big laurel leaf;
But somehow the race never ended,
For both of them came to grief.
A blackbird pounced down on the slug,
And bore him away for his dinner;
The snail tumbled off in fright,
So neither of them was the winner.

NEW DICTATION TESTS.—STANDARD IV.

Suitable for 'Unseen Tests' in Reading also.

52.

The animal population of some islands in the Pacific is strange. At present there are on the islands wild cattle, horses, and goats, also a race of wild asses which have developed a remarkable habit of sitting up on their haunches. Wild dogs roam about as well as flocks of fowls, and on some of the islands cats live in crevices of lava near the coast, living by hunting for crabs and fishes. But perhaps the gigantic land tortoises that are found on the islands constitute their most curious feature.

53.

The lobster is greatly in dread of thunder, and when the peals are very loud numbers of them drop their claws and swim away for deeper water. Any great fright may also induce them to drop their claws. But new claws begin at once to grow, and in a short time are as large as the old ones, and covered with hard shells. The lobster often drops its shell, when it hides, until the new shell is hard enough to protect it.

54.

The 'butcher' bird's name is given to him because of his cruel habits. He will fly about in company with a number of small birds, then when opportunity offers will pounce on one and carry it off and kill it. It is a very amusing pet, as it will imitate all sound that it hears. They persecute their victims so relentlessly that it is generally found, that where they abound, there are hardly any small birds. All prey that they do not eat at once they spike on the thorns of bushes.

55.

Robins are among the most useful of all birds for destroying insects which are injurious in fields and gardens. They rear two or three broods of young ones each season, and require unnumbered grubs to feed them upon. A young robin will consume more than its own weight of worms and grubs daily. From examinations of the contents of the robin's stomach it was found, by an American naturalist, that no vegetable food was taken by this bird from early in March to the first of May.

56.

If the earth as it revolved round the sun stood quite upright there would be no succession of seasons. The sun would always shine with the same directness on the different parts—hot, straight, and strong on all the regions round the equator, but indirectly and weakly towards the north and south poles. In the regions near the equator it would be perpetual summer, in the polar regions perpetual winter, and in the middle regions perpetual spring.

57.

A cow was observed a few days ago to be in great agony, and eventually dashed its head against the walls of its shed, breaking its neck. On examination, a live snake and six young ones, also two water newts were found in its throat. The extraordinary circumstance has attracted great local interest. It is supposed that the animal swallowed the reptiles while drinking from a brook.

58.

A pin manufacturer in the United States is about to use some twenty barrels of imperfect pins in making a sidewalk in front of his residence. There is in that town a small piece of sidewalk composed of scraps from the pin factory, which by corrosion had become so hard in a few years that it required much hard work in drilling and blasting with dynamite to make a hole large enough to set a telegraph pole, although it was but three or four inches thick. It bids fair to last as long as a sidewalk of solid brass.

59.

Be kind to thy father; for when thou wert young,
  Who loved thee as fondly as he?
He caught the first accents that fell from thy tongue
  And joined in thine innocent glee.
Be kind to thy mother; for lo! on her brow
  May traces of sorrow be seen;
Oh, well may'st thou cherish and comfort her now
  For loving and kind hath she been.

STANDARDS V.–VII.

43.

A single editorial paragraph in a newspaper will often, if you scan it narrowly, disclose a good deal touching the mental and moral personality of the man who wrote it, and will even tell you something about the editor who allowed the copy to be printed. Then again, a topic outlined in a newspaper will or should press upon you the inquiry, what is your own view of the subject, and how would your view be best expressed? There is, indeed, scarcely any limit to the stimulation which a single newspaper may offer to an active, tenacious and well-directed mind.

44.

They that disbelieve in God's providence are no wiser than they that believe in it, they themselves openly declare that they do not believe because they do not know, and meantime knowledge is wisdom, and they certainly are no happier. Thus it seems self-evident that in the beginning of misfortune to be able to experience not only non-resistance and submission to fate, but acquiescence and loving trust, is the part of religion and duty, to be sure, but that it is also, in view of its capacity of producing comfort and happiness, the part of worldly wisdom also.

45.

Keble had a stern, and also a kind and loving, side, and those who came in contact with the harsher side misjudged him, and thought him deficient in benevolence. One of his friends said that had he lived in the days of bigotry and persecution, he would have kindled the fire which was destined to burn a heretic, but would have washed it out with his tears. It was once remarked that he acted on a most singular principle in the formation of his opinions. 'I have known,' observed a friend of his, 'many others who held notions which were weak, but I never knew anyone but you who adopted them precisely because they were so.'

46.

The increase of remunerative work to be done by the educated who desire to live by their brains, and, if possible, by the professions recognised as conferring a diploma of presumable culture and leaving the workers gentlemen in their own eyes, bears no proportion to the increase in the numbers of those who contend for it. We cannot give the figures, for there are and can be no statistics of the total of work to be divided, but everyone knows that in every profession the young are more and more disappointed, that competition grows ever keener, and that the numbers who admit that they make absolutely nothing is becoming bewildering.

47.

A present to a child could not take a worthier form than that of a book, and wise parents will take care that, whatever other luxuries they give to their children, they provide them with a library as large and as excellent as their means will allow. It may only be a small shelf, but the biggest library in the world is no more than a number of shelves, one added to another; so that there is nothing very absurd in children calling their tiny collection a library, even though the same title is bestowed upon the most important assemblage of books the world contains.

48.

We have all heard of the admirable tempering of kindness with severity that prevails in the prisons of the United States of America, that it is worth while, in order to adjust our ideas, to catch an occasional glimpse of the other side of the picture—even if that other side be, as it may be, a trifle distorted or exaggerated. The thing aimed at over there, is not so much the punishment, as the reformation of the prisoner—no so much, the exacting of the last farthing of vengeance for an outraged law, as the raising of the criminal to such a pitch of respect for law and order, and to such a passion of regard for virtue, that he loses his taste for vice, and crime becomes impossible.

49.

The largest literary work ever issued under the authority and at the expense of the British Government is undoubtedly the report of the scientific results of the voyage of the *Challenger*. It is officially estimated that, including sums voted for scientific work in connection with the expedition since the voyage was completed, at least eighty-eight thousand pounds have already been expended on this work, of which sum up to the present only eighteen thousand pounds have been recovered by sales. The report is now nearly complete, and thirty-six volumes have already been issued.

50.

O Thou! whose balance does the mountains weigh,
Whose will the wild tumultuous seas obey,
Whose breath can turn those watery worlds to flame,
That flame to tempest, and that tempest tame;
Earth's meanest son, all trembling, prostrate falls,
And on the boundless of thy goodness calls.

Oh! give the winds all past offence to sweep,
To scatter wide, or bury in the deep;
Thy power, my weakness, may I ever see,
And wholly dedicate my soul to Thee.

TEACHING NOTES ON 'THE LIFE AND DUTIES OF THE CITIZEN.'

By the authors of 'Hughes's Constitutional Reader: a Series of Lessons on the Life and Duties of the Citizen.' (Published by Joseph Hughes & Co., Froebel House, St. Andrew's Hill, Doctors' Commons, E.C.)

LESSON IV.—Local Government (Health and Comfort).

I. Local Bodies.

County Councils, Town Councils, &c. (See Lesson VII.) In addition to these bodies there exist Sanitary Authorities—Rural and Urban—the former generally the Boards of Guardians, the latter the Vestry, Town Council, or Local Board.

II. Aids to Health and Comfort.

1. *Cleanliness.*—Water supplied by private companies—in some cases by local bodies. Public baths and washhouses built and maintained by local authorities and chargeable to rates. Dust cleared and roads cleaned by local bodies.

2. *Sanitation.*—Sanitary officers appointed to superintend work of sanitation generally. Owners of houses compelled to keep them in good sanitary condition.

3. *Open Spaces* provided and maintained as public recreation grounds by County Councils, Town Councils, &c.

4. *Hospitals* for infectious diseases are established for isolation of patients by local bodies. Hospitals for general diseases, built and supported by private benevolence and public subscriptions. (Point out need and duty of citizen supporting these institutions.) Many hospitals have institutions for teaching sick-nursing attached to them. (Importance of careful nursing in cases of sickness.)

5. *Paving and Lighting* of streets, making and maintaining roads, works of public improvement.

6. *Gas.*—Either supplied by private companies or power acquired by local bodies.

III. The Citizen's Duty.

To promote health and comfort of community generally (1) by practising *personal* cleanliness, temperance, &c.; (2) by taking pride and pleasure in maintaining in good condition open spaces and public buildings generally; and (3) by helping to alleviate, as far as possible, sickness, trouble, and poverty around him.

Read 'C.R.,' Chapter 8.

LESSON V.—Local Government (Protection and Poverty).

I. Protection.

Citizen needs protection against those who, failing to rise to full conception of duties and responsibilities of citizenship, live a life of crime and form danger to well-being of State. Hence police, magistrates, prisons.

1. *Police.*—Two kinds—borough (city) and county. Former in cities and boroughs population over 10,000, appointed by town council and paid out of borough rate; latter in counties and small towns, appointed by joint committee of County Council and magistrates.

City of London Police, under a Commissioner appointed by Corporation; Commissioner of Metropolitan Police appointed by Home Secretary, and therefore directly responsible to Government.

Work of police. To preserve order and to place under arrest those committing a breach of the peace. *Detectives*, plain-clothes policemen, appointed for the investigation of more complicated cases.

2. *Magistrates.*—Two kinds, county and borough; former appointed by Lord Chancellor, generally on the nomination of the Lord Lieutenant of the county, the latter directly by Lord Chancellor. County magistrates unpaid, but in London and other large centres of population *stipendiary* (paid) magistrates appointed, and in some cities *recorders*, from men experienced in the law. Only lighter kinds of offences adjudicated upon at local police-courts and by magistrates sitting in petty sessions, more serious cases at quarter sessions or assizes; former county magistrates with chairman, latter one of her Majesty's judges. (See later lesson.)

3. *Prisons* maintained by County Councils for retention of convicted criminals.

II. Poverty.

The State recognises the duty of providing for destitute and sick poor.

1. *Relief*—indoor and outdoor—granted by Boards of Guardians. (See lesson VII.) Each Poor Law Union provided with workhouse, where indoor relief is given to all in real need, in return for which inmates perform whatever work they can. Outdoor relief in less severe cases, consisting of grants of food, money, etc. Casual ward for vagrants—one night only at a time. Schools for pauper children. Infirmaries for sick poor. Relieving officer appointed to inquire into all cases and to help the Guardians in administering relief.

III. The Citizen's Duty.

1. To cheerfully obey the laws, and to aim at a high standard of duty, both to himself and his fellow citizens.

2. To endeavour to provide against old age and infirmity by careful saving in early manhood and health.

Read 'C.R.,' Chapters 6 and 9.

LESSON VI.—Local Government (Rating and Expenditure).

I. Expenditure.

Work of local bodies cannot be carried on without considerable amount of expense: (1) in providing buildings suitable and necessary for special local purposes; (2) in employment of men to perform necessary work; and (3) in relieving poor.

II. How the Money is provided.

By means of rates. These rates paid by householders (generally) and property owners. Amount paid depends upon *rateable value*—that is, net value after charges upon it paid (generally about one-sixth less than gross value). (Example. House at £40 annual rent, would be about £33 rateable value, the £7 being estimated annual value of repairs, ground rent, etc.)

Smallest area for rating purposes is the civil parish. Local bodies, area of which spreads over more than one parish, estimate at stated times (quarter, half-year, or year) amount of money required, and *precept* sent for each parish to subscribe proportionate amount required from it. (Teacher will illustrate this by a specific example, such as London School Board, Middlesex County Council, etc.)

III. Local Loans—Auditors.

Most local government bodies have power of obtaining loans, with the sanction of the central authority. Town Councils and other bodies may also hold property, the income of which, if any, is used for reduction of taxation.

The Local Government Board (central authority) appoints auditors to examine the accounts of local bodies, and to see that the money has been legitimately spent.

IV. Demand Note.

At quarterly or half-yearly intervals a paper called a 'Demand Note' is left at the house of every ratepayer, stating (1) rateable value at which he is assessed, (2) particulars of the rate demanded (that is, proportion to be paid for different specific purposes), and (3) the total amount of money demanded. This amount must be paid before a certain date, or a summons is issued. The payment of this money can be enforced by a magistrate. Every parish elects *overseers*, one to four in number, whose chief duty is to collect, or cause to be collected, the poor rate—that is, the rate required by the poor law authorities.

V. The Citizen's Duty.

1. To take his part in selecting representatives upon local bodies, and in this way decide how the money raised by the rates shall be spent.

2. To endeavour, by a judicious outlay of the ratepayers' money, to ameliorate the general conditions of life. (Starving local bodies for funds, and thus rendering them inefficient, is false economy; at same time, reckless expenditure of money should be strongly condemned.)

Read 'C.R.,' Chapter 10.

LESSON VII.—Local Government Bodies.

Name.	Area.	Qualification of Candidate.	Qualification of Elector.	Constitution of Body.	Time for which Elected.	Mode of Election.	Work.	Place of Meeting.
1. County Council -	Counties and certain large towns.	Ratepayer or property owner of an assigned value within district (man).	Ratepayer (man or woman) and owners of property within district of assigned value (County electors).	(*a*) Chairman. (*b*) Aldermen. (*c*) Councillors. (Committees)	(*a*) one year. (*b*) six years—one-half retiring every three years. (*c*) three years.	(*a*) Aldermen and councillors. (*b*) Councillors. (*c*) Ballot of electors.	County roads, bridges, lunatic asylums, police and police stations, public improvements, open spaces, fire brigades, main drainage, land allotments, &c.	Capital of County generally. Special offices or otherwise.
2. Cities and Municipal Boroughs	Cities or Incorporated Boroughs (Charter).	Do.	Do. (Citizens, Burgesses).	(*a*) Mayor (Lord Mayor) (*b*) Aldermen. (*c*) Councillors. (Committees)	(*a*) one year. (*b*) as above. (*c*) three years—one-third retiring each year.	(*a*) Aldermen and councillors. (*c*) Ballot of electors.	General local management, but not police if population less than 10,000.	Municipal buildings.
3. Vestry (Select or Special)	Civil Parish of Metropolitan Area, and in some of Provinces.	Ratepayers of assigned rateable value.	Do.	Chairman, Vice-chairman, Members, Vestry Clerk if population 2,000 (last-named is permanent official).	Same as councillors above.	C. and V.C. by members. Members by ballot (generally, but sometimes by show of hands).	Rating, lighting, paving, draining, free libraries, public baths, washhouses.	Vestry Hall, if population 4,000.
4. District Local Board	Suburban Area, populous parts of counties, and unincorporated towns and boroughs.	Same as (1).	Do.	Do. (Clerk).	Do.	Paper left at houses of ratepayers.	Lighting, paving, cleaning streets, &c.	Offices.
5. Poor Law Union	Area defined by Local Government Board.	Do. (man or woman).	Do.	Do. (Guardians).	One year (generally).	Do.	Relief of poor (indoor, outdoor); casual ward; sick poor; destitute children, Rural Sanitary Authority	Do.
6. School Board -	Area defined by Education Department.	Any man or woman over 21.	Do.	Do.	Three years.	Ballot (cumulative) vote.)	Elementary Education, schools, school places, school maintenance.	Do.

Notes on the above Scheme.

(1.) This scheme is meant to indicate the *general* plan on which these bodies are constituted.

(2.) Vestry. In parishes which have not a 'select' vestry, the vestry meeting is attended by all the ratepayers of the parish. Such bodies are 'decrepit survivals, and, as far as any practical efficiency is concerned, their duties are *nil*.'

(3.) Parish Councils will form the subject of a special lesson subsequently.

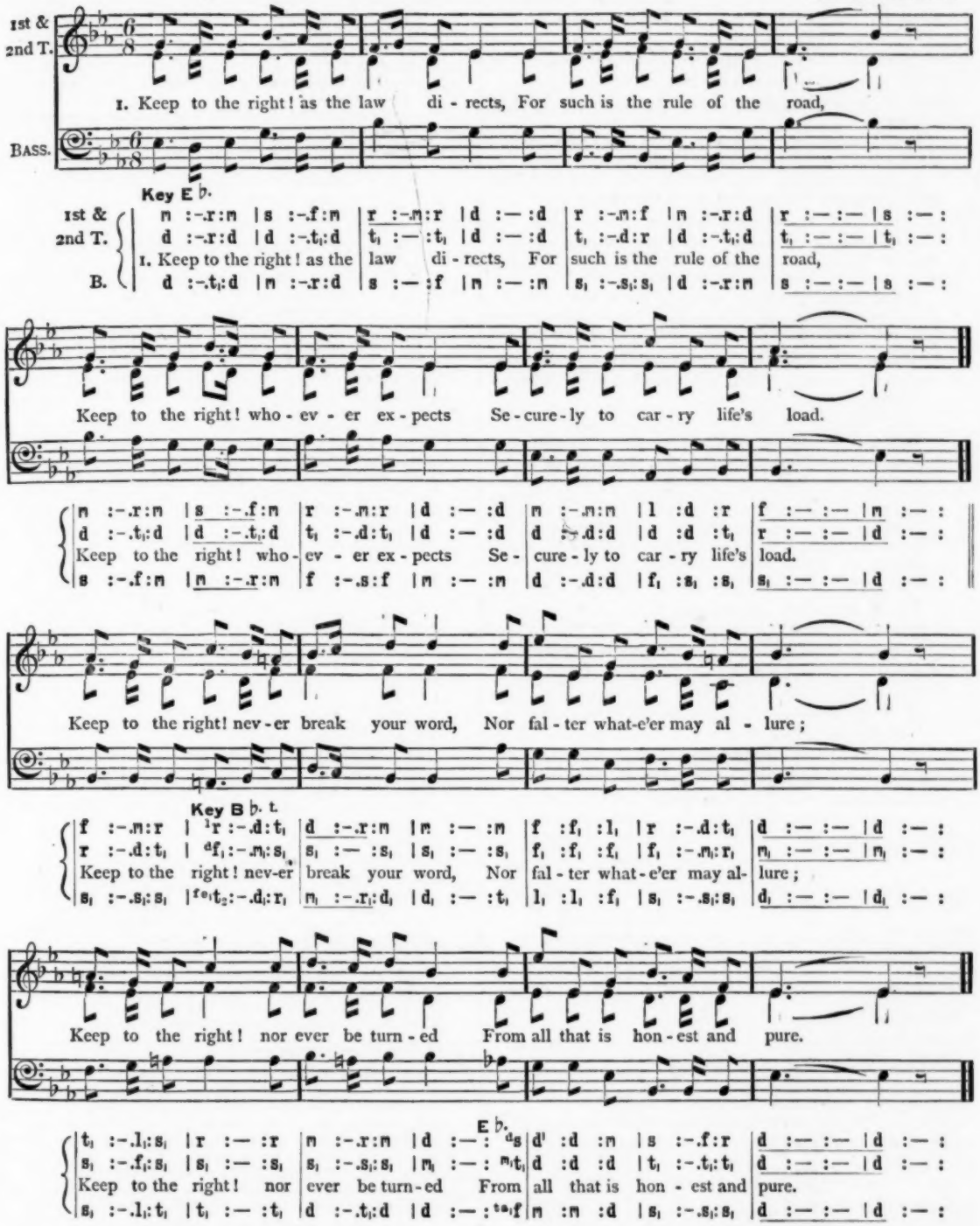
(4.) For 'Mayor' read 'Lord Mayor' in the cases of London, Dublin, York, Manchester, and Liverpool.

(5.) Other bodies exist, but they should be dealt with only in those cases where they are in operation.

Highway Boards (rural); Conservancy Boards (rivers); Burial Boards (cemeteries).

A fuller account of these bodies is given in 'C.R.,' Chapters 4–7.

KEEP TO THE RIGHT.

GERMAN MELODY.

1st & 2nd T.
BASS.
1. Keep to the right! as the law di - rects, For such is the rule of the road,
Key E♭.
Keep to the right! who - ev - er ex - pects Se - cure - ly to car - ry life's load.
Keep to the right! nev - er break your word, Nor fal - ter what-e'er may al - lure;
Key B♭.
Keep to the right! nor ever be turn - ed From all that is hon - est and pure.
E♭.

2. Keep to the right! both within and without,
With stranger, and kindred, and friend,
Keep to the right! and swerve not nor doubt
That all will be right in the end.

Keep to the right in whate'er you do,
And claim but your own on the way;
Keep to the right! hold on to the true
From morn to the close of the day.

OUR PUPIL TEACHERS' COURSE.

I. In response to various enquiries we append, without any comment, the WESLEYAN RELIGIOUS KNOWLEDGE SYLLABUS FOR PUPIL TEACHERS.

October (last Saturday), 1893, *and March (first Saturday)*, 1894.

I.—CANDIDATES.

1. The First Catechism (omitting the Appendix). Revised edition.

2. Old Testament. Genesis, 12 to 14. Text book: *Maclear's Shilling Book*, pages 10 to 17.

3. New Testament. St. John's Gospel, 1, 2, 3. Text book: *Maclear's Shilling Book*, pages 40 to 46.

II.—PUPIL TEACHERS.

1. The Second Catechism. First Year, Chapters 1, 2, 3. Second Years, Chapters 4, 5, 6. Third Year, Chapters 7, 8, 9. Fourth Year, Chapters 1 to 10 inclusive.

2. Old Testament History, including the following periods: From the departure from Sinai to the death of Moses; Joshua and the Conquest of Western Palestine; Period of the Judges.

Text Books.—First Year: *Maclear's Shilling Book*, pages 39 to 68. Second, Third, and Fourth Years: *Maclear's Class Book*, pages 167 to 266.

Principal Subjects:—Kadesh Barnea and the Mission of the Spies, Numbers, 10 to 14. The Wanderings—Death of Miriam and Aaron, Numbers, 15. to 21. Conquest of the East of Jordan—Balaam and Balak, Numbers, 21 to 24. War with the Midianites—Death of Moses, Numbers, 25 to 32. The Passage of the Jordan and Fall of Jericho, Joshua, 1 to 6. Conquest of the Southern and Central Mountains, Joshua, 7 to 11. Battle of Merom and Division of the Land, Joshua 11 to 21. Events subsequent to the Death of Joshua, Judges, 1. Micah and the Danites—the Tribal War. Judges, 17 to 21. Othniel and Ehud—Deborah and Barak, Judges, 2 to 5. Invasion of the Midianites—Gideon, 6 to 8. Abimelech and Jephthah, Judges, 9 to 11. Invasion from South-West—Samson, Judges, 13 to 16.

3. New Testament History, including the following Periods:—From the Feast of Tabernacles to the Triumphal Entry into Jerusalem; and from the Arrival at Bethany to the Ascension.

Text Books.—First Year: *Maclear's Shilling Book*, pages 67 to 96. Second, Third, and Fourth Years: *Maclear's Class Book*, pages 230 to 338.

GOSPELS.

Principal Subjects.	St. Matt.	St. Mark.	St. Luke.	St. John.
Feast of Tabernacles—Hostility of the Sanhedrin	—	—	—	Ch. 7. 11—53. 8. 1—11.
Opening the eyes of one born blind	—	—	—	8. 12—59. 9; 10. 1—21.
Mission of the Seventy—Discourses and Miracles	—	—	Chs. 10, 11, 12, parts. 13. 1—17	—
Feast of Dedication—Tour in Perœa	—	—	13. 31—35. 14, 15, 16	10. 22—41.
Raising of Lazarus	—	—	—	11. 1—44.
Resolve of the Sanhedrin—Jesus retires to Ephraim	Ch. 19. 1—20. 1—28	Ch. 10. 1—45	17. 11—37. 18; 19. 1—10	11. 45—57.
Anointing at Bethany—Triumphal Entry	21. 1—11	11, parts. 14. 1—9	19. 11—44	12. 1—19.
Second Cleansing of the Temple	21. 12—46	11, parts. 12, parts	20. 1—19	—
Day of Questions—Inquiring Greeks	21. 15—46. 23, 24, 25	12. 13—44. 13. 1—3	20. 20—47	12. 20—36.
Compact of Judas—The Last Supper	26. 1—29	14. 10—25	22. 1—30	13. 1—38. 14—17.
Agony and Betrayal—Peter's Denial	26. 20—75, parts	14. 26—72, parts	22. 31—62	18. 1—27.
The Jewish Trial—Remorse and Suicide of Judas	26, part. 27. 1—10	14, part	22. 63—71	—
Trial before Pilate—Condemnation	27. 11—30	15. 1—19	23. 1—31	18. 28 to 19. 16.
The Crucifixion	27. 31—54	15. 20—39	23. 32—48	19. 17—37.
The Burial and Resurrection	27. 55—66. 28. 1—17	15. 40—47. 16	23. 49—56. 24. 1—12	19. 38—42. 20. 1—10.
The Great Forty Days and the Ascension	28. 18—20	16. 12—20	24. 13—53	20. 19—31; 21. Acts 1. 1—13.

II.—HOW TO STUDY GEOGRAPHY.

(*a*) Have an excellent atlas of large size if possible.

(*b*) Have *two text-books*, one a mere skeleton, like 'Blanchard's Notabilia,' and the other in full detail, as in Brooks' Geography.

(*c*) As far as text-books are concerned use *only* the above two, nevertheless,

(*d*) Don't neglect general reading concerning the countries under study.

Sometime or other during apprenticeship the following books should be read:—

(1) 'In Darkest Africa,' or a summary of it, published by Walter Scott.
(2) Lady Brassey's 'Voyage of the Sunbeam.'
(3) Darwin's 'Voyage of the Beagle.'
(4) Captain Maury's 'Cruise of the Challenger.'
(5) Wallace's 'Travels on the Amazon.'
(6) Barth's 'Travels in Abyssinia.'
(7) Such books as Drake's, Anson's, Dampier's, Cook's Voyages, and such novels as Mayne Reid's, Ballantyne's, and Henty's.

(*e*) Have pencil in hand for purpose of underlining important facts, and for marginal notes and comments.

(*f*) Let the map be always before you for reference sake, and don't forget to utilise the large wall maps belonging to the school.

(*g*) Draw as many maps as you can, not only of physical features and political details, but of flora, fauna, and minerals, and of ethnological and commercial particulars. These should generally be executed not as a special map-drawing lesson, but during the perusal of the text-books.

(*h*) Get an early knowledge of Physical Geography and Physiography. (We strongly recommend the latter as the very best Science to be taken for Scholarship-mark-earning purposes.)

These subjects will not only overlap the ordinary course, but, by ensuring that the causes and reasons of many effects and facts are well understood, will raise many parts of Geography out of the province of mere remembrance, will employ the higher faculties and assist and relieve the memory.

(*i*) The broad facts of a country with respect to its topographical and astronomical position, its slope, elevation, aspect, and situation with regard to large bodies of water, ocean and wind currents, must all be duly known and appreciated.

When the principal factors are normal, the flora, fauna, many of the products, and many of the circumstances of exports, imports, and commerce in general, will be known from ordinary principles.

When some of the principal factors are abnormal (such as high elevation under the tropics), then will the student understand what deviations will also follow, and much tread-mill work of learning off by heart will be avoided.

(*j*) Study Geography relatively, by contrast and comparison with well-known standards. What avails it to know that Snowden is not 3,600 feet but 3,571 feet high?

Utilise any coincidences of figures, even if they be not absolutely accurate, as long as they do not convey a wrong impression.

Thus, remember area of British Isles by figure 11.

Area of British Isles = 11 × 11 thousands of square miles.
Area of Great Britain = 11 × 8 thousands of square miles.
Area of Ireland = 11 × 3 thousands of square miles.

(*k*) Compile a geographical note-book, but write in it not as much as possible, but as little as may be.

It should contain only those facts which are not otherwise accessible, and references to sources of information external to the ordinary text-books.

(*l*) After the first reading, the text-books should be so marked that in subsequent perusals the salient parts can be seen at a glance, the portions to be omitted can be easily discerned, and the minor facts denoted in order of importance.

In modern text-books the student is greatly assisted by the varieties of type denoting differences in importance, yet still he will need some selective and organising marks of his own. One common method is by repeated underlinings according to the weight attached to the passages. This is a very simple and excellent means where the printed lines are far enough apart, and where the margin is sufficiently broad.

An ingenious and youthful friend of ours employs the contractions of musical terms to guide his future study.

e.g., *fff* = very important, learn by heart.
ff = important, learn the substance.
f = interesting, read carefully.
p = ordinary matter, merely glance throught it.
pp = of little value.
ppp = omit in future reading.

and many other adaptations to denote literary style.

(*m*) Geographical study must not only take physical and political lines, but should also be taken *as a whole*, ethnologically, ethically, historically, biologically, and commercially.

(*n*) Special attention should also be given to points that have a temporary interest owing to current events, or that possess fictitious importance on account of Departmental favoritism.

(*o*) The art of drawing maps must be particularly practised, and the lines of latitude and longitude of the maps required must be accurately learnt.

III. MATABELELAND, MASHONALAND, ETC.

As our readers are aware, the above countries have just been the scene of 'a little war' between the British South African Company (slightly assisted by the Imperial Government) and the Matabeles.

The attention directed to, and the interest naturally aroused towards these regions, has been intensified by persistent questions in the House of Commons hostile to the above Company.

The district between the Lower Zambesi and the Limpopo or Crocodile River, which constitutes the northern part of British South Africa, is called Zambesia, and is about 250,000 square miles in area. The Mashonas live to the south of the Zambesi, and the Matabeles still nearer the Limpopo; but the former were tributary to the latter. The Barotse stretches from the north of the middle course of the Zambesi to the north of the Transvaal. In the centre of Zambesia runs a series of granitic ranges, which, in the picturesque Matoppo and Mashona Mountains, reaches a height of 4,500 feet. The direction of the most easterly range is nearly due north and south, but those to the westward trend more to the south-west.

From this watershed rise numerous streams, which feed the Zambesi and Limpopo, and water the country fairly well. The chief town, Buluwayo, capital of Lobenguela, chief of the Matabeles, is situated at the southern slope of the Matoppo Mountains. Other towns are Tati (Tete), the centre of extensive mining operations, and Shoshong.

The rainfall is regular and sufficient, the altitude sufficient to ensure health, and the soil well adapted in great part for agriculture. It is a country where Englishmen may hope to see their children grow up strong and healthy, without the necessity of sending them to the mother country, as our Indian settlers are compelled to do.

While the high central table-land is suitable for the white man, the low-laying regions to the east and near the Zambesi can be developed by Indian coolie labour, and is well suited for plantation work. It is an invaluable field for the extension of Britain and South Africa.

The colony was founded in 1890 by an amicable concession from king Lobenguela; gold was almost immediately worked in Mashonaland by native labour, and steady progress for a time followed.

This pacific improvement was, however, foreign to the genius of the Matabeles, who are a blood-thirsty race of Zulu origin and military organisation. For several generations they have been accustomed to hunt down the Mashonas as we do rabbits, and the *matjaka*, or young unmarried soldiers, are not allowed matrimony until they have proved their manhood by human slaughter.

Since 1890 the British have protected the inferior race, not only from motives of humanity, but because the Mashonas are necessary to assist in the fast developing gold industry.

This interference was bitterly resented by the *matjaka* (who had never known defeat) and they forced on a war, with the result that, after two decisive defeats, they have either dispersed or retreated across the Zambesi. The future government of the country will be the subject of negociations between the British Government and the Company, but South African feeling is strenuously opposed to imperial dictation, which, if unwisely exercised, will lead to disaster.

The Matabeles possess much of the raw material of a peaceful and hard-working people, and a certain proportion has already laboured with profit in the Transvaal, and even in Mashonaland. But at present the flower of the nation is locked up in the prevailing military system. Once this caste is broken down, a race of fine physique and courage will be available for the purposes of civilization.

IV. SOUTH AFRICA IN GENERAL, however, looms large on the imperial horizon, and it is probable that to us and our posterity no external subject is fraught with such deep practical issues.

In the Transvaal we have, within the last three months, secured greater privileges for Englishmen and a more favourable attitude towards railway extension. Before many years the ever-increasing majority of settlers of British descent will be overwhelming enough to bring about a peaceful union with British South Africa.

It is not only on its vast territorial merits that South Africa is being recognised as a land of marvellous resources, it has generally a healthy climate, where cloudless skies, continuous sunshine, and dry air can be enjoyed. The western half and the south away from the coast have a scanty rainfall, and the vegetable products are poor. These, however, can be greatly increased by irrigation, whilst the mineral wealth is enormous, the deposits being exceedingly varied and apparently inexhaustible.

During the last 24 years the diamond industry has yielded £57,000,000, and the gold 'output' for the present year is at the rate of £5,000,000.

The early history of Australia will probably be repeated in South Africa, where the development was stimulated in such a wonderful degree by gold.

The South African resources of coal, iron, copper, asbestos, salt, and fire-clay, are invaluable, and are indeed absolutely essential to the gold industry.

Imports and exports have already amounted to £35,000,000 per annum, and are growing by leaps and bounds; and a magnificent empire in the future will testify to the indefatigable energies, and the undaunted enterprise of the imperial Anglo-Saxon race.

V. SALIENT POINTS OF GEOGRAPHY *for the different years.*

(i.) FIRST YEAR. (*a*) *British Isles.* What are the chief industries of Stirling, Dundee, Norwich, Londonderry, Macclesfield, Newcastle-on-Tyne, Sheffield, Blackburn, Derby, Dublin, Belfast, Stoke-on-Trent, Bradford, Merthyr Tydvil, Middlesborough, Coventry, Kidderminster?

What are the chief commercial rivers of England and Scotland? Shew that they are well adapted for trade, name their towns, and the occupations carried on therein.

Give some account of the chief places passed in coasting from the Nore to Plymouth. Describe any three rivers on the west coast of Great Britain. Describe the physical features of Ireland. Describe a coasting voyage from Liverpool to Plymouth; from Londonderry to Queenstown; from Glasgow to Aberdeen.

Name four principal ports of England, Scotland, and Ireland. Point out their position and imports and exports. Describe the river system of Scotland.

Say what you know of Dartmoor, Grampian, Plain of York, Strathclyde, Stonehenge, Wirrall, and the Goodwins.

What parts of the British Isles produce the best horses, mutton, butter, cheese, apples, wheat, hops, oats, flax, sheep, and poultry?

Where, what, and what noted for are Bath, Derby, Norwich, Swansea, Halifax, Perth, St. David's, Oban, Limerick, Aberdeen, Waterford, Albany, Dundee, Queenstown, Sunderland, Stirling, Farne, Holy, Londonderry, Valentia, Fylde, Fens, Furness, St. Andrew's, St. Alban's, and The Potteries?

(*b*) *British North America.* Trace the course of a ship from Chicago to Montreal, noting the towns on the lakes, and the features of the river from Ontario to Montreal. Describe a journey by rail from Montreal to Vancouver.

Briefly describe the great lakes. What other system of North American lakes is there?

What do you know of the seal-fishery, the salmon-fishery, and the fur industry.

Give some account of the Canadian lumber trade.

Where, what, and what noted for are Ottawa, Halifax, New Westminster, Albany, Regina, Baffin, Hooker, Labrador, Abraham, Canso, and Great Bear?

Describe the climate of Canada, enumerate its provinces and the chief towns of each. Explain the names Montreal, Nova Scotia, Newfoundland, Hudson's Bay.

What effect have its mountain ranges upon the climate of British Columbia?

(*c*) *Australia.* Name the chief productions of Queensland, New South Wales.

Give some account of the physical features, climate, and industries of New South Wales, South Australia, West Australia, Victoria, Queensland, and Tasmania, and compare their areas with Great Britain.

What is known of the interior of Australia?

Give some account of the Australian pearl-fishery and gold-digging.

Describe the plants, animals, and minerals of Australia.

Where, what, and what noted for are Bathurst, Sydney, Ballarat, Burdekin, Albany, Flinders, Great Barrier Reef, Perth, Brisbane, Hobart, Melbourne, Perth, Rockhampton, and Tamar?

Say what you know of the political and commercial condition of New South Wales and West Australia.

(*d*) *Physical Geography of Mountains and Rivers.*

What is a mountain range, chain, group, knot? What is a volcano? Explain volcanic action and mention the chief lines of volcanic activity?

Compare the disposition of the mountain ranges of England, Scotland, and Ireland. What continents resemble these countries in the arrangement of their mountain systems?

What do you mean by the snow-line? Give particulars.

Describe the characteristics of each part of a river which has an upper, a middle, and a lower course.

Explain the terms watershed, water parting, river basin, with especial reference to the Severn, Shannon, Tay, St. Lawrence, and Murray. What other geographical river terms can you mention?

What is a delta? What conditions are necessary to its formation?

Give instances of rivers rising in lakes, swamps, glaciers.

Give instances of rivers flowing into lakes and lost in deserts.

What different causes have been at work in the formation of the mountains, valleys, and rivers of our globe?

What connection is there between mountain ranges and continental islands?

(*e*) *Maps.* East coast of Ireland; Scotland; Basins of Clyde, Forth and Tay; Irish Sea and St. George's Channel; Basin of Thames; Southern counties from North Foreland to Portland Bill; Wales; Scotland, North of Forth; Great Britain; Basin of Seven and Wye; Basins of Mersey, Ribble, Lune, Eden; Ireland; England, physical; England, political; England, South of Thames; six Northern counties of England; Ulster; and England east of a line from Yarmouth to Southampton.

(*f*) *Miscellaneous.* Describe briefly a journey from Liverpool to Vancouver, crossing North America by land; from London to Perth (Australia) *via* Canadian Pacific Railway; from Southampton to Sydney.

Explain how the commerce and navigation of the Rivers Tay, Shannon, Tyne, Mersey, Severn, and Murray, are determined by the nature of their basins.

Compare the climate of the British Isles with that of Vancouver's Island and Tasmania.

(ii.) SECOND YEAR. (*a*) *Europe.* Describe the basin of the Danube. Name the inland seas and the countries they wash. Compare and contrast the Baltic and Mediterranean. Name the chief cities of Holland.

Mention the principal rivers, with their sources and towns, flowing into the North and Baltic Seas.

Where, what, and for what noted are Stettin, Frankfort, Avignon, Prague, Poitiers, Seville, Bruges, Antwerp, Genoa, Adrianople, Belgrade, Corfu, Cordova, Sofia, Cettinje, Madrid, Berlin, Cracow, Naples, Cadiz, Heligoland, Munich, Florence, Altona, Dresden, Brindisi, Rome, Innsbruck, Varna, Valetta, Geysers, Landes, Basques, Samoyards, Magyars?

Describe a land journey from Calais to Salonica; from Madrid to Constantinople; from Berlin to Sophia; from Paris to Brindisi.

Describe a voyage from London to St. Petersburg; from Southampton to Valetta; from Gibraltar to Odessa.

What places and scenes near to London, St. Petersburg, Brussels, Madrid, and Constantinople, are worthy of a visit, and why?

Name the foreign possessions of any two European Powers. What are the chief industries of South France, North Russia, and Sweden?

What do you know about the Dutch people and their language?

Name some of the most famous buildings in Europe. Say where each of them is situated and what makes it famous.

Name some of the greatest engineering achievements in Europe, and explain their utility.

(*b*) *British India.* What are the chief exports of India? What goods does it take from us?

Describe the river system of Hindostan?

Give some account of the Indus.

Where, what, and for what noted are Surat, Moorshedabad, Allahabad, Delhi, Singapore, Simla, Madras, Lucknow, Kurachee, Colombo, Agra, Poonah, Meerut, Lahore, Calicut, Bangalore, Rangoon, Trincomalee, Deccan, Sunderbunds, Nizam, Thugs?

Describe a coasting voyage from Calcutta to Bombay.

Give some account of the Government of India. Enumerate the independent and tributary states of India.

What is meant by the 'Scientific Frontier'? Mention the passes through which an invader can descend upon North-West India.

Give some account of the Ceylon Pearl Fishery.

(*c*) *Climate and Productions.* Enumerate the productions of the various districts of Australia and New Zealand. Name the productions of three of the tropical lands under British rule. Name the chief products of the districts of British India. Name the chief European centres for wine, wheat, olives, oranges, silk-weaving, horse-breeding, tobacco, timber, tallow, and steel.

Describe the climate of the Australian Colonies. Show what political and climatic influences any of the mountain ranges of Europe and Asia have had upon adjacent countries. Describe the climate and productions of Ceylon and Jamaica. What do you know of the climate and productions of British South Africa?

Say what you know of the causes, effects, and times of the Monsoons in North and South India.

What are the chief productions of Ceylon, Assam, Lombardy, and Holland?

Explain the physical causes of the healthiness or insalubrity of Singapore, Calcutta, Sierra Leone, Cape Town, Demerara, Larnaka, and Quebec.

Name the principal animals, trees, and fruit which are met with in India and in Australia, and not in England.

(*d*) *Maps.* France, Spain, Portugal, France North of Loire, Basins of Seine and Loire, Spain and Portugal, coast from Marseilles to Seine.

(*e*) *Latitude and Longitude.* Define West Longitude, South Latitude, Arctic Circle, Great Circle, Equator, Meridian, and Parallel of Latitude. How are latitude and longitude measured? How many degrees of longitude correspond to an hour of time? Show that degrees of longitude are of unequal length in different latitudes.

When it is noon by the sextant it is 3.30 p.m. by the chronometer. What is the longitude of the ship? How does a sailor ascertain his latitude and longitude?

What is the difference in time between 45° W. long. and 135° E. long., between 45° W. long. and 15° E. long, between 45° E. long. and 75° 36′ W. long.?

A place is in 45° N. lat. and 2° E. long. Whereabouts would it be on the map of Europe, and what would its time be compared with Greenwich?

When it is noon at Greenwich what time is it at 45°, 30°, and 175° E. long., and 30° and 175° W. long.?

In going round the world from E. to W. how is a day apparently lost?

Explain as to Standard VI. the reason of difference of time in different longitudes.

Give approximately the latitude and longitude of London, Paris, Gibraltar, Rome, Berlin, Constantinople, and Copenhagen.

Gibraltar is situated in 36° 8′ N. lat., and 5° 20′ W. long. Find its distance in miles from the equator and its time when it is noon at Greenwich.

(iii.) THIRD YEAR. (*a*) *Asia.* 'Large rivers flow into the Asiatic gulfs and assist commerce.' Prove this.

Describe the course of a ship from Calcutta to Japan. Mountain system of India.

Obstacles to Asiatic exploration.

Name the seas on East of Asia. What do you know about the Red Sea, as to its situation, character, trade, ports, and surrounding country?

Describe the course of the mails from London to Shanghai *via* Brindisi.

Give notes of a first lesson on the great physical features of Asia, on Japan and Japanese.

Where and what are Tundra, Vladivostock, Goa, Kandy, Darjeeling, Aleppo, Yemen Khelat, Victoria, Corea, Penang, Candahar, Tomok, Damascus, Jaffa, Tonkin, Teheran, Medina, Kars, Euphrates, Godavery, Agra, Tokio, Madras, Ispahan, Astrakhan, Hong-Kong, Smyrna, Agra, Merv, Sikhs, Mongols, Arabs, Parsees, Malays, Trichinopoly, Neilgherry, Hyderabad, Elephanta, and Nerbudda?

What countries in Asia are governed by England, Turkey, and Russia?

Give size and population of China, and describe briefly its six largest towns.

Give some account of the Indo-Chinese peninsula, Siberia, China, and Persia.

Give some account of the government and social life of Japan.

(*b*) *Africa.* 'The rivers as well as the lakes of Africa are most unequally distributed over the continent. Most of them have rapids and cataracts in their middle course, and short and ill-developed lower course, and dangerous sand banks at their mouth.'

Prove the above statement.

Obstacles to African exploration. Voyage up Nile. Voyage up Congo.

Where and what are Tamatave, Zanzibar, Soudan, Durban, Khartoum, Kimberley, Bechuanaland, Madeira, Algeria, Souakim, Stanley Falls, Mombassa, Timbuctoo, Hottentots, Tangier, Constantine, Fez, Coomassie, Ujiji, Gondar, Congo, Victoria Falls, Cairo, Damietta, Kenai, Mashonas, Rosetta, and Suez?

What do you know of the coast between the Congo and Niger, and between Guardafui and the Zambesi?

What are the principal additions to our knowledge of Equatorial Africa, recently made by Stanley?

Say what you know of the country between the head-waters of the Congo, Nile, and Zambesi.

(*c*) *Winds.* Describe the two most regular systems of winds? Where do we meet with irregular winds? What do you know of periodical winds?

Distinguish between climate and weather. Cause, duration, and effects of monsoons.

Account for the prevalence of S.W. and N.W. winds, respectively, in certain parts of the globe; and state their effects on the ocean surface and on the lands adjoining.

Why in summer at the coast does a sea-breeze spring up in morning and die away in afternoon?

(*d*) *Ocean Currents.* What is meant by constant, periodical, counter, and drift currents?

Name the chief ocean currents, and show how they are affected by the earth's diurnal motion.

Describe the great Polar current.

(*e*) *Maps.* South Africa, Coast of Bay of Bengal, Hindostan, Cape Colony, E. half of Mediterranean, Ganges, N. coast of Mediterranean.

(*f*) *Miscellaneous.* Voyage from Cape to Bombay.

How are ships affected by winds and currents in sailing from Liverpool to Sydney by the Suez Canal, and back by Cape of Good Hope?

Compare and contrast the physical features of Asia and Europe.

Model Answers to Geography.

(Oct. '93 Exam.)

Boys and Girls.—First Year.

Answer three questions only, including Question 6 *if you can.*

1. Give some account of the physical features of Ireland.

The surface of Ireland consists chiefly of a *Great Central Plain*, which nowhere rises more than 250 ft. above the sea-level.

The country near the coast rises up into hills and mountains, forming a ring-shaped rampart, through which numerous rivers break, and thus take inland water to the sea.

A great feature of Ireland is its extensive bogs; the Bog of Allen is 240,000 acres in extent.

There are numerous lakes; the largest is Lough Neagh, in Ulster (150 sq. mls.).

The Slieve Bloom Mountains rise up in the middle of the of the Central Plain, thus forming an important watershed.

The climate is moist and genial, arising from its insular position. Its great humidity renders it peculiarly verdant. Hence it is called 'The Emerald Isle.' The most mountainous portion is Kerry and Cork; highest point, Carntual (3,400 ft.). The west coast is very much indented, owing to the action of the Atlantic Ocean.

2. Describe the climate of Canada; enumerate its provinces and the chief towns of each. Explain the names Montreal, Nova Scotia, Newfoundland, and Hudson's Bay.

Great extremes of summer heat and winter cold are felt in all parts, and the temperature, according to latitude, ranges from the utmost Arctic cold to the most genial of the temperate zones. The atmosphere, however, is dry as compared with England. Thus, the intense cold of winter is not unpleasant, but bracing.

Provinces.	Towns.
QUEBEC - - -	*Quebec*, Montreal, Three Rivers.
ONTARIO - - -	*Ottawa*, Toronto, Kingston, Hamilton.
NEW BRUNSWICK -	*Fredericton*, St. John, Newcastle.
NOVA SCOTIA - -	*Halifax*, Sydney, Cornwallis.
PRINCE - EDWARD - ISLAND.	*Charlottetown.*
BRITISH COLUMBIA	*Victoria*, New Westminster, Vancouver.
MANITOBA - -	*Winnipeg*, Selkirk, Emerson.
KEEWATIN and N.W. TERRITORY.	*Churchill*, Fort York.
ASSINIBOIA - -	*Regina*, Fort Pelly.
SASKATCHEWAN -	*Carlton*, Battleford.
ALBERTA - - -	*Calgarry*, Edmonton.
ATHABASCA - -	*Dunvegan.*

Name.	Explanation.
MONTREAL - -	The town was founded in 1640 on the site Hochelega, an Indian village. The hill behind the village was called by the French Mont Royal—Mont Real; whence Montreal.
NOVA SCOTIA - -	Cabot arrived here 1497. James II. tried to found a Scots colony here. Name means New Scotland.
NEWFOUNDLAND -	Cabot also arrived here 1497. The name explains itself—New found land.
HUDSON'S BAY -	Called after Hudson, who discovered it in 1610. His men turned him adrift in an open boat.

3. Name any interesting facts associated with Londonderry, Holy Isle, Iona, Stirling, Valentia, Farne Islands.

Londonderry is in Ireland on the Foyle; it is famous for the terrible siege it sustained from James II. in 1689. It still preserves its old walls and the cannon on them used in defence.

Holy Isle is off Northumberland, and a religious establishment was founded by Aidan of Iona in A.D. 634. Hence the name Holy Isle.

The old Abbey of Lindisfarne was formerly the resort of pilgrims.

Iona (or Icolmkill).—One of the Hebrides: A monastery was established here by Columba, a native of Ireland, in 563. Forty-eight Scotch Kings, four Irish Kings, and eight Norwegian Kings were interred there. (It was one of the earliest monasteries in the kingdom.)

Stirling is a town on the Forth. It has one of the most historic castles in Scotland. It was frequently the residence of Scottish Kings. Wallace gained a brilliant victory here in 1297. It was recaptured and held till Edward II. lost it at Bannockburn, 1314.

Valentia is an island off Kerry, and was so named by the Spaniards. Three cables run to Trinity Bay from Valentia; the first being laid in 1866.

Farne Islands are near Holy Isle, and are noted for the heroic deeds of Grace Darling, who, during a terrible gale, saved the crew of a wrecked ship.

4. Say what you know of the following: Plain of York, Fylde, Fens, Grampians, and Dartmoor.

The *Plain of York* is the agricultural valley of the Ouse. The western portion is noted for its manufactures. This plain

has been the scene of many severe battles, some of them being —Stamford Bridge, 1066; Marston Moor, 1644; Towton, 1461; Winwidfield, 655, etc.

The *Fylde* is the name given to that portion of Lancashire between Preston and Fleetwood. Thus, we say Poulton-in-Fylde. The country is level and rather marshy. The Jacobite army of 1715 was defeated here.

The *Fens* are a flat marshy district about the Wash. Much land has, however, been gained, and agriculture is in a flourishing state. Most of the land used to be under water. Thus, we read of Ely (ey, island). In the *Isle* of Ely (Eel ey) rents used to be paid for eels.

Hereward made a brave resistance here, 1071.

The *Grampians* are a range of lofty mountains nearly 100 miles long, stretching across Scotland and dividing it into 'The Highlands' and 'Lowlands.' Salmon and trout are plentiful in the streams and lakes which abound in the hills. Grouse-shooting and deer-stalking are favourite sports.

Dartmoor is a *table-land* of moor between 1,000 and 2,000 ft. high. It is in Devonshire. Granite is produced in large quantities.

A convict prison is on the top.

5. What is known of the interior of Australia? Describe the positions of Sydney, Melbourne, and Brisbane.

About three-fourths of the interior of Australia is filled by a low plateau which rises gradually from south to north and from west to east. This interior low plain is a vast concave table of sandstone, with an area of about one and a half million square miles. The central depression is filled by Lake Amadeus. The edges of this plain are in many parts bordered by terraced ramparts of mountains. In the extreme west of this plain we find large deserts; in the north-west a well-wooded country (Kimberley district); in the north, a country covered by scrub and crossed by the telegraph wire to the south, where, as well as in the eastern portion, we find a grassy country suitable for cattle-rearing and sheep-farming.

Sydney is in New South Wales (Australia), on Port Jackson, 34° S.L.; 151° E.L.

Melbourne is in Victoria (Australia), on Port Philip (at the mouth of the Yarra Yarra), 37½° S.L.; 145° E.L.

Brisbane is in Queensland (Australia), on the River Brisbane, 27° S. L.; 153° E.L.

6. Draw a map of Great Britain.

BOYS AND GIRLS.—SECOND YEAR.

(*Answer three Questions only, including the last if you can.*)

1. What are the chief industries of the South of France, of the North of Russia, and of Sweden?

(*a*) Taking Southern France as meaning that portion south of 46° N.L., we find that *agriculture* takes a prominent place in the industries. The *vineyards* are very productive, about three million acres being under cultivation in this part of the country. Other things receiving great attention are the *olive*, *maize*, *mulberry tree* (planted for the use of the silkworm), *melons*, *oranges*, and *figs*.

The three great centres of industry are—

(1.) *Lyons*, at the confluence of the Rhone and Saone, which produces £20,000,000 worth of *silk* annually.

(2.) *Bordeaux*, at the mouth of the Garonne; it is the great *wine* shipping port. The town has also large *sugar refineries*, *potteries*, and *foundries*.

(3.) *Marseilles*, on the south coast; it is the greatest commercial port in France.

St. Etienne, near the Upper Loire, is the chief seat of the *ironworks* of France. There are large and rich *coalfields* in this neighbourhood. *Salt* is made from the lagoons on the south coast.

(*b*) The chief industry in *Northern Russia* is *lumbering*, in the forest which extends from *Onega* to the *Mezen*. This forest produces *timber* (birch, pine, etc.), *resin*, and *potash*.

Mines are sunk in the Ural Mountains for the sake of the *platinum*, *magnetic iron ore*, and *coal*.

Barley, *flax*, and *hemp* are grown in great quantities. Fossil ivory is also found. *Hunting* is a great industry, *fur* being procured from the *bear*, *wolf*, *lynx*, and *fox*. *Tallow* is made in large quantities and exported.

(*c*) The chief industry in *Sweden* is *Agriculture*. The chief products are *wheat* and *barley*.

The second industry is *Mining*, *iron ore*, *zinc*, *copper*, and *coal* being found.

Lumbering comes next. Excellent timber is produced, the different kinds being *pine*, *birches*, *firs*, *ash*, *elm*, and *oak*.

The commercial ports are *Stockholm*, *Gothenburg*, and *Gefle*.

2. Where and what are Poitiers, Delhi, Seville, Singapore, Surat, Bruges, Antwerp, Genoa?

Place.	Position.	Description.
POITIERS -	Is in France, in the province of Poitou, Dept. Vienne, N.L. 47°, E. L. ½°.	Town famous for battle of Poitiers gained by Black Prince 1356.
DELHI - -	In India, on River Jumna. N. L. 28°, E. L. 76°.	The ancient capital of Mogul Empire, and is the centre of the Moslem world in India. It took a prominent part in the Indian Mutiny, 1857.
SEVILLE - -	In Spain, on the River Guadalquiver. N. L. 37°, W. L. 6°.	Town which manufactures tobacco and has large trade in oranges.
SINGAPORE -	An island (Br. Poss.) south of Malay Peninsula. N. L. 1°, E. L. 102°.	Small island; has immense commerce; it is important as a provision station.
SURAT - -	In India, on the River Taptee. N. L. 22°, E. L. 72°.	Trading port on West Coast; was first trading port of East India Company.
BRUGES - -	In Belgium, W. Flanders. N.L. 51¼°, E. L. 3½°.	Once great manufacturing town, but now decaying. Paupers abound.
ANTWERP -	In Belgium, on the Scheldt. N. L. 51¼°, E. L. 4½°.	Largest port in Belgium, and strong fortress.
GENOA - -	In Italy, on Gulf of Genoa. N. L. 44½°, E. L. 9°.	Chief seaport of Italy. Great railway centre. Birthplace of Columbus.

3. Give some account of the climate and productions of Victoria (Australia).

Victoria has a salubrious climate, but it is comparatively dry. It is liable to droughts and heavy rains. The rainy season is from May to October (winter). Its climate is very suitable for Europeans.

Victoria owes its great importance to its *agricultural* and *mineral* wealth. *Wool*, *tallow*, *hides*, and *skins* are largely exported. Vast quantities of *gold* are sent to England, and there are valuable deposits of *iron* and *tin* ores, *copper*, and *coal*.

4. State what you know of the Dutch people and their language. Name the chief cities of Holland.

The Dutch *character* has been determined chiefly by two things—the long contest with the Spaniards, and the perpetual struggle against water.

Thus we find that they love *freedom*, and are very *independent*, *hardworking* and *thrifty*, *brave*, *self-possessed*, and *generous*.

They are fond of old customs and old costumes. Their most remarkable external virtue is *cleanliness*.

The *Dutch Language* belongs to the *Low German* family of languages, and is very like the English and Flemish. The Dutch spoken in Friesland, called Frisian, bears the strongest resemblance to English. The following is both good English and Frisian:—

'Good butter and good cheese
Is good English and good Fries.'

The Dutch say *moder* for mother, *stroom* for stream, *huis* for house, and *zee* for sea.

The chief cities in Holland are—

Amsterdam, the capital, on Zuyder Zee (population 380,000). It is a large port, and is famous for diamond-cutting.

The Hague (140,000). This town is the seat of government.

Rotterdam is the chief port of Holland. *Leyden* and *Utrecht* are university towns.

5. Explain the terms West Longitude, South Latitude; what is the difference in time between a place in 45° W. Longitude and 135° E. Longitude? How is railway time reckoned in the United States?

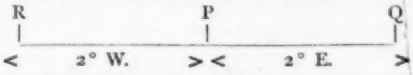
West Longitude is distance measured (along parallels of latitude) west of any given meridian. English-speaking people measure from the Greenwich meridian.

South Latitude is distance measured (along meridians of longitude) south of the equator.

The earth revolves once in 24 hours; and as a circle contains 360° we pass through 360° in 24 hours, or through (45° + 135°) = 180° in 12 hours.

12 hours difference. Ans.

We gain 4 min. per degree of longitude on original starting time travelling West, and lose 4 min. per degree going East. If it takes a train 4 hours to go 2° of longitude, and if time at



P is 1 o'clock, it would be timed to arrive at R not at 5 o'clock, but at 8 min. to 5; and if it was going East the time at Q would be 8 min. past 5, thus adding 4 min. per degree to original starting time going East, and deducting the same going West.

6. Draw a map of the Spanish Peninsula.
See good atlas.

BOYS AND GIRLS.—THIRD YEAR.

(*Answer three Questions, including the last if you can.*)

1. Compare and contrast the physical features of Asia and Europe.

A COMPARISON.

EUROPE.	ASIA.
1. Contains many large peninsulas.	1. Contains many large peninsulas.
2. The most important run to the South:	2. The most important run to the South:
Spain corresponds to Arabia.	
Italy ,, ,, Hindostan.	
Balkan Peninsula ,, ,, Further India.	
Scandinavia ,, ,, Kamschatka.	
3. Has a large archipelago to the south-east.	3. Has a large archipelago to the south-east.
Sicily corresponds to Ceylon.	
The Ægean Isles ,, ,, the Sundas and Philippines.	
4. The Rhine, Rhone, and Danube rise near each other.	4. The Indus, Ganges, and Brahmapootra rise near each other.
5. Rivers flow to all points of compass.	5. Rivers flow to all points of compass.
6. Highlands and tablelands in south.	6. Highest tablelands are in the south.

A CONTRAST.

EUROPE.	ASIA.
1. Europe is the smallest continent.	1. Asia is the largest continent.
2. Is a continent of varied features.	2. Is a continent of vast and monotonous plateaus.
3. Has a small trunk—peninsulas are ⅓ of area.	3. Asia has a very large trunk—peninsulas fill only ⅓ of area.
4. Europe has very long coastline.	4. Asia has proportionately only ⅓ of Europe's coast line.
5. Mountains of Europe belong to second class in height.	5. Mountains of Asia are highest in the world.
6. Europe has no twin rivers.	6. Asia has several pairs of twin rivers.
7. Europe only *shares* with Asia a continental basin.	7. Asia has the largest continental basin in the world.
8. Europe has on the whole a marine climate.	8. Asia has almost everywhere a continental climate.
9. Europe is easily accessible from North to South.	9. Asia is accessible only from east to west. Its tablelands prevent easy communication with North and South.

2. Name the seas on the East of Asia, and write what you know of the Red Sea, as to its situation, extent, character of surrounding country, trade, and ports.

2. The Sea of *Khamschatka* between Asia and Behring Sea.
The Sea of *Okotsk* (infested by fogs).
The *Japan* Sea.
The *Yellow* Sea, containing the Gulf of Pe-chi-li.
The *East* Sea, between China and Loo-Choo Islands.
The *China* Sea, containing the Gulfs of Tonquin and Siam.

The *Red* Sea is situated between Asia and Africa, and also between the Mediterranean Sea and the Indian Ocean. It extends from 32° to 43° E. Longitude, and from 13° to 30° N. Latitude, and is over 1,000 miles long.

The countries bounding it are Arabia (El Hejaz and Yemen), Egypt, and Nubia. El-Hejaz is a very hot and very dry country. Most of the country is desert; the coast is fringed by extensive coral reefs and sunken rocks. Yemen is the most fertile part of Arabia. The most valuable plants are the date-palm and coffee plants.

The Sinai region is a rocky limestone plateau, a wilderness of rocks and arid plains. The Israelites wandered here 40 years. The African side is mostly desert, the surrounding country being extremely hot.

Since the opening of the Suez canal trade has developed rapidly, gums, tobacco, indigo, cotton, dhurra, ivory (Nubia), sugar, gum arabic, and coffee are exported.

The chief ports are Mocha, Suez, Suakim, Massowah, Zulla, Jeddah, and Tembo.

3. Where and what are the following: Medina, Kars, the Euphrates, the Godavari, Agra, Bechuanaland, Madeira, and Algeria?

Place.	Position.	Description.
MEDINA - -	In Arabia (El Hejaz) N.L. 25°, E.L. 40°.	Town which contains the tomb of Mahomet.
KARS - - -	In Russian Trans-Caucasia, N.L. 42°, E.L. 43°.	A formidable stronghold; town built of lava blocks.
EUPHRATES - -	A great river (1,700 m.) which rises in the highlands of Armenia, flows in a S.E. direction, and with the Tigris encloses Mesopotamia. It flows in the Persian Gulf. The site of Babylon is on it.	
GODAVARI - -	A river (900 m.) in India. It rises in the W. Ghauts, and crosses the Deccan, draining an area as large as the British Isles.	
AGRA - - -	In India, on the Jumna. N.L. 27°, E.L. 77°.	Large town, celebrated for the beauty of the Taj-Mahal. Took minor part in Mutiny, 1857.
BECHUANALAND	In South Africa (British), between rivers Molopo and Orange. Br. Protectorate, S.L. 22° to 28°, E.L. 20° to 32°.	Large country in Kalahari Desert. The Bechuanas are cattle-rearers and maize growers.
MADEIRA - -	Off Morocco, in Atlantic Ocean, W.L. 18°, N.L. 34°.	Islands of volcanic formation. Exports cochineal and sugar. Health resort.
ALGERIA - -	In N. Africa, between Morocco and Tunis, W.L. 4° to E.L. 8°, N.L. 30° to 37°.	Large country belonging to France. Once a pirate resort. Exports esparto grass, olives, etc.

4. What is meant by constant, periodical, counter, and drift currents?

Constant Currents are those whose course is regular and permanent. They are caused by the combined action of the winds, differences of temperature, and rotation of the earth. The Gulf Stream is an example of a Constant Current.

Periodical Currents are those which only flow at particular seasons of the year, or during certain hours of the day. They are caused by the action of the tides and of the monsoons and periodical winds.

Counter Currents are those which run in an opposite direction to other currents. The North Polar Current is counter to the Gulf Stream.

Drift Currents are those which consist of a movement of the surface of the water in obedience to the force of the wind.

5. Give some account of the government and social life of Japan. Name the countries in Asia which are—

(i.) Under the rule of the Empress of India.
(ii.) ,, ,, ,, Czar of Russia.
(iii.) ,, ,, ,, Sultan of Turkey.

The *Government* of Japan is an absolute monarchy, the head of which is the Mikado. He has under him a Supreme Council and a Legislative Council.

Before the Revolution of 1868 the country was governed by the Shogun, or chief vassal of the Mikado. The Mikado was regarded as an 'Emperor God,' who must never be seen by his subjects, but only worshipped.

A popular government has been promised the Japanese.

Social Character.—The Japanese are kind-hearted, gentle, courteous, amiable, temperate, orderly, and thrifty. The labouring classes are hard-working, calm and patient, and submit without complaint to the greatest hardships and privations. They are clever and ingenious. Their industry is ceaseless; they have no Sabbath, and only take a holiday when they have nothing to do. Their spade-husbandry turns their country into one beautifully-kept garden.

In *Asia* the Empress of India rules India, Ceylon, Aracan, Pegu, Tenasserim, Assam, Burmah, Straits Settlements, Hong Kong, Aden and Perim, Labuan, Sarawak (Borneo), Hong Kong, Kowloon, Kuria Muria I., Andaman and Nicobars, Kamaran I. (Protected countries—Cyprus, Beloochistan).

The Czar of Russia rules Trans-Caucasia, Russian Central Asia (Western Turkestan, the Khanates of Khokand, Khiva, Bokhara), and Siberia.

The Sultan of Turkey rules Asia Minor, Syria (Palestine), Armenia, Mesopotamia, parts of Arabia (Yemen-el-Hejaz, El-Hassa.)

6. Draw a map of South Africa.
See good atlas.

First Year.

1. (*a*) In how many different ways may a Vulgar Fraction be regarded?

(*b*) Find the least common multiple of £15 4s. 2d. and £13 7s. 6d.
Ans. £4,881 17s. 6d.

2. (*Boys.*) How many packets of tobacco, each containing 3·7 ounces, can be made up from 150 lbs.? What quantity of tobacco will there be left over. Answers, 648 packets; $2\frac{4}{37}$ ozs.

(*Girls*). Find the G.C.M. of 14003 and 11591, and show that no other number can be their G.C.M. Ans. 67.

3. (*Boys.*) Simplify $\cfrac{2}{6-\cfrac{2}{6+\cfrac{2}{6-\frac{2}{6}}}}$ Ans. $\frac{51}{176}$.

(*Girls.*) By how much is the sum of $6\frac{1}{8}$ and $9\frac{1}{12}\frac{5}{8}$ greater than the difference of $19\frac{1}{16}$ and $4\frac{3}{8}$? Ans. 1.

4. Write in Largehand the words—
Physiology, Quag, Rhythm, Stylograph, Trowel.
Write in Smallhand—
'Procrastination is the thief of time,
Year after year it steals, till all are fled.'

5. Analyse the following lines and parse the italicised words:—
'*So saying*, from the court *we* paced, and gained
The *terrace ranged* along the Northern front,
And, *leaning there* on *those* balusters, *high*
Above the empurpled champaign, *drank* the gale.'

6. (*a*) What is meant by Agreement or Concord in English Syntax? (*b*) Quote any rules on this subject, and illustrate them by sentences.

7. Write a life of the Venerable Bede.

8. Draw a map of the North Sea.

9. (*a*) Describe the climate of Canada. (*b*) Enumerate its provinces, and the chief towns of each. (*c*) Explain the names *Montreal*, *Nova Scotia*, *Newfoundland*, and *Hudson's Bay*.

10. Explain the theory that 'In many river valleys, the stream has at some time or other flowed over every portion.'

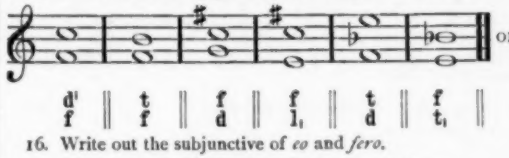
11. For what events were the years 43, 120, 296, 410, 449, and 664 noted.

12. Explain these word-terminations: *cester*, *by*, *wick*, *wick*, and what they tell us about the history of our country?

13. Describe the conversion of Northumberland to Christianity.

14. Would you give Dictation or Spelling Tests to Standard I? Give reasons.

15. Name the following intervals, as major third, &c.:—



d¹	t	f	f	t	f
f	f	d	l₁	d	t₁

16. Write out the subjunctive of *eo* and *fero*.

17. Give the perfect indicative of *possum* and *timeo*.

Second Year.

1. (*Boys.*) (*a*) Distinguish, as to a class, between stock and the money value of a stock, illustrating by an example. What is meant by buying at a premium?

(*b*) Explain the term '*Brokerage.*' How much brokerage is by custom charged for the transfer of £500 stock from a 4 per cent. stock @ $103\frac{1}{4}$ to a 3 per cent. stock @ $98\frac{1}{2}$?
Ans. Total Brokerage = £1 5s. $7\frac{40}{107}$d.

(*Girls.*) Reduce $(\frac{3}{11}$ of $6\frac{1}{6}) - (\frac{7}{11}$ of $3\frac{1}{11}) \times 5\frac{1}{13}$ to a simple fraction in its lowest terms. Ans. $\frac{7}{286}$.

2. (*Boys.*) If the amount at $3\frac{3}{4}$ per cent. per annum simple interest after $50\frac{2}{3}$ years is £13,195, what is the principal?
Ans. £4,550.

(*Girls.*) Find the value of $\frac{3}{80}$ of a ton — $\frac{1}{4}$ of a cwt. + $3\frac{3}{4}$ of 20 lbs. Ans. 3 qrs. 13 lbs. 8 ozs.

3. A moidore being worth 27 shillings, what is the least debt in dollars worth 4s. 2d., which can be paid in moidores?
Ans. 162 dollars.

4. As in First Year.

5. Paraphrase—
'*Even there*
The listless wave *that* stole with hollow voice
Where reeds grow *rank* on the rushy-fringed brink,
And the green sedge *bent* to the wandering wind,
Sang with a cheerful song of sweet tranquillity.
Men felt the heavenly influence—and it stole
Like balm into their hearts, *till all was peace.*'

6. Analyse the above passage and parse the italicised words.

7. What Verbs may take the Nominative case after them? Give instances.

8. Draw a map of the Spanish Peninsula.

9. Name the products of three of the various tropical lands under British rule.

10. Describe the position of *Madrid*, *Berlin*, *Cracow*, *Naples*, *Simla*, *Madras*, *Lucknow*, and *Delhi*.

11. Give the dates of Introduction of Scutage, Constitutions of Clarendon, Assize of Northampton, the Saladin Tithe, and deaths of Henry II. and Richard.

12. What do you know about *The Good Parliament?* Show that it was well so called.

13. Write out a table of the Plantagenet Line.

14. (*Boys.*) Write out Euclid I. 10.
The perpendiculars from the extremities of the base upon the sides of an isosceles triangle are equal.

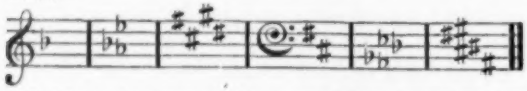
(*Girls.*) How would you make a rice and a bread pudding?

PUPIL TEACHERS' ROUTINE FOR JANUARY, 1894.

DAYS	YEARS	FIRST WEEK			SECOND WEEK			THIRD WEEK			FOURTH WEEK		
		First Lesson	Second Lesson	Third Lesson	First Lesson	Second Lesson	Third Lesson	First Lesson	Second Lesson	Third Lesson	First Lesson	Second Lesson	Third Lesson
MONDAY	1	Analysis and Parsing *or* Latin (See Article)	How to teach Writing	Physical Geography of Rivers	Analysis and Parsing *or* Latin (See Article)	Vulgar Fractions of Wts. & Measrs. Bracketed Vulg. Fractions	Dates from 901 to 975 A.D.	Analysis and Parsing *or* Latin (See Article)	How to teach Arithmetic	Reduc. of Vulgs. to Decimals. Comp. Practice	Composition or Paraphrasing *or* Latin (See Article)	How to teach Spelling	Red. of Decimals to Vulgars. Simple Proportn.
	2			Latitude		Percentages. Simple Practice	Dates from 1327 to 1360 A.D.		How to teach Mental Arithmetic	Percentages. Compound Practice			Misc. Problems
	3		How to teach Form.	Winds		Compound Practice. Simple Proportion	Dynastic Tables		How to teach Colour	Stocks. Fractions of Money		How to teach Number	Square Root Fractions of Measures
TUESDAY	1	Euclid I. 5. Paper Patterns of Garments	Map of Irish Sea	Scripture *or* Revision	Euclid I. 6. Knitting Sock	Lives of Great Historic Personages	Scripture *or* Revision	Euclid I. 7. Stocking-hole mending	Physical Geography of Rivers	Scripture *or* Revision	Euclid I. 8. Paper Patterns of Garments	Subtr. of Algebra. Stocking-hole mending	Mensuration *or* Domestic Economy
	2	Euclid I. 7, 8. Paper Patterns of Garments	Map of Italy		Euclid I. 9, 10, 11. Knitting Stocking			Euclid I. 12, 13. Calico Patch	Longitude		Euclid I. 14, 15. Paper Patterns of Garments	G.C.M. of Algebra. Flannel Patch	
	3	Euclid I. 37, 38, 39. Paper Patterns of Garments	Map of South Africa		Euclid I. 40, 41. Any Needlework			Euclid I. 42, 43. Hedge-tear Darn	Ocean Currents		Euclid I. 44, 45. Paper Patterns of Garments	Simple Equations. Hedge-tear Darn	
WEDNESDAY	1	History from 1012 to 1042 A.D.	Prefixes, Roots, or Affixes, *or* Latin	Science	History from 1042 to 1066 A.D.	Any Geography	Science	History of the 'Heptarchy'	Prefixes, Roots, or Affixes, *or* Latin	Science	Dates from 795 to 1035 A.D.	Circulating Decimals. Bills of Parcels	Science
	2	History from 1327 to 1376 A.D.			History from 1370 to 1399 A.D.	Latitude		History from 1410 to 1422 A.D.			Dates from 1399 to 1422 A.D.	Stocks. Vulgar Fractions of Weights	
	3	History from 1649 to 1660 A.D.			History from 1660 to 1678 A.D.	Ocean Currents		Battles of the Great Rebellion			Constitutional Struggle of the Stuart Period	Stocks. Simple Proportion	
THURSDAY	1	Geography of Scotland	Multip. of Algebra. Paper Patterns of Garments	Drawing	Geography of Australia	History of Roman Period	Drawing	Geography of Australia	Metric System	Drawing	Geography of Ireland	History from Egbert to Canute	Drawing
	2	Geography of Europe	Divisn. of Algebra. Paper Patterns of Garments		Geography of India	History from 1399 to 1410 A.D.		Climates of British Empire			Productions of British Empire	History from 1422 to 1461 A.D.	
	3	Geography of Africa	Algebraic Fractns. Paper Patterns of Garments		Geography of Asia	History from 1678 to 1685 A.D.		Geography of Asia			Geography of Asia	History from 1685 to 1688 A.D.	
FRIDAY	1	Vulgar Frac. of Money, Measures, and Multiples	Theory of Music	Drawing	Vulgar Fractions of Measures. Any Add. or Sub. of Vulgar Fractns.	Multiplication of Algebra. Knitting Sock	Drawing	Multip. of Decimals. Easy Multip. of Vulgar Fractions	Vocal Music	Drawing	Circulating Decls. Household Accounts	Map of Ireland	Drawing
	2	Proofs of Required Rules.			Miscellaneous Problems	Div. of Algebra. Knitting Stocking		Stocks. Mixed Vulgars and Decimals			Stocks. Vulgar Fractions of Money	Map of Spanish Peninsula	
	3	Miscel. Problems. Simple Proportion			Prst. Worth, Disct. Mixed Vulgars and Decimals	Square Root of Algebra. Any Needlework		Stocks. Fractions of Weights			Stocks. Simple Proportion	Map of Mediterranean Sea	
SATURDAY	1	French *or* Latin	English from Text Book *or* Latin	Freehand, Perspective *or* Geometry	Science	French *or* Latin	Science	English *or* Latin	Mensuration	French *or* Latin	Literature. Repetition	Examination	French *or* Latin
	2												Science
	3												Examination

15. Work out fully, as on a blackboard before a class, the following sum, so as to show the separate value of each figure in the answer, and also of each of the remainders :—

Divide £7,387 16s. 4½d. by 17. Ans. £434 11s. 6½d.

16. State what major keys are shown by the following signatures :—

OR

Which are the strong or pillar tones of the scale, and which tones have the greatest leaning tendency?

17. Decline *pastor, pinus, castra.* Write down the genitive plural of *canis, cor,* also the genitive singular of *iter, tellus.* Give genders of *panis, senectus, ver,* OR,

How are the feminines of French adjectives ending in *f, x, el, eur* generally formed? Give examples.

THIRD YEAR.

1. (*Boys.*) (*a*) Prove that if a vulgar fraction in its lowest terms be equivalent to a terminating decimal, the denominator of that fraction can only contain the prime numbers 2 and 5.

(*b*) Without reducing to Vulgar Fractions—

(α) Multiply 2·15 by ·25. Ans. ·538.

(β) Subtract 1·725 from 2·14. Ans. 416.

(*Girls.*) (*a*) When is a fraction said to be in its lowest terms?

(*b*) Reduce to its lowest terms $\frac{8888}{8888}$, and find the value of that fraction of £1 3s. 7½d. Answers, $\frac{317}{317}$; £1 2s. 7½d.

2. (*Boys.*) A mixture is made of 297 gallons at 17s. 9d. per gallon, 132 gallons at 22s. 6d. per gallon, and 121 gallons at 19s. 4d. per gallon. Find the price of a gallon of the mixture?

Ans. 19s. $2\frac{43}{60}$d.

(*Girls.*) Find the value of 27 tons 18 cwts. 4 lbs. of corn, when a bushel weighing 62½ lbs. costs 3s. 9d.

3. A train leaves London at 10 a.m., reaching Portsmouth at 1.15 p.m. Another train leaves Portsmouth at 6.15 a.m., reaching London at 11.30 a.m. At what time do they meet?

Ans. 10 hrs. $34\frac{7}{7}$ mins.

4. As in First Year.

5. Paraphrase the following :—

'Milton *has involved* in his account of "The Fall of Man" the *events which* preceded and *those* that were *to follow* it; *he* has interwoven the whole system of theology with *such* propriety *that* every part appears to be *necessary.*'

6. Analyse the above passage and parse the italicised words.

7. Comment on these sentences, and say whether they are incorrect, and, if so, why :—

(*a*) I never remember to have seen him.
(*b*) Select the first four names in the list.
(*c*) It could not have been him.
(*d*) The matches will only light on the box.
(*e*) I could have wished that he had been here.

8. Draw a map of South Africa.

9. Where are *Ispahan, Souakim, Smyrna, Agra, Merv, Tokio, Hong-Kong, Mombassa,* and *Timbuctoo*?

10. Explain the terms *Monsoon, Great Polar Current.* Explain why, in summer at the seaside, a sea breeze springs up in the morning and dies away in the afternoon?

11. Give dates of Statute of Fines, Execution of Warbeck, Field of Cloth of Gold, Death of Wolsey, Martyrdom of Joan Bocher, Loss of Calais?

12. How do you account for the spread of knowledge in the Tudor Period? Name three eminent scholars who then flourished?

13. What do you know of Empson, Latimer, Rizzio, Sir Philip Sidney, and Lyly?

14. (*Boys.*) Write out Euclid I. 32.

Prove that the sum of the sides of a triangle is greater than twice the line joining the vertex to the bisection of the base.

(*Girls.*) What do you know of water as a beverage? Describe any precautions that should be taken to render it innocuous.

15. What is the meaning of the distinction between *Physical, Political, Mathematical,* and *Industrial Geography?* Say which of these should be first taught, and why?

16. State briefly the meaning of the following terms :—

(*a*) *Pianissimo,* (*d*) *Forte,*
(*b*) *Staccato,* (*e*) *Ritard,*
(*c*) *Mezzo piano,* (*f*) *Dolce.*

17. Give the principle parts of *arcesso, scindo, juvo, uro ;* also the infinitive and 1st person singular, present, indicative of *pacisceve, vincti sumus, velit ;* OR,

Write out the imperative of *avoir,* the conditional of *parler,* the imperfect subjunctive of *finir,* the present indicative of *recevoir,* the preterite of *venir.*

THE 1894 SCHOLARSHIP EXAMINATION.

BY DR. GEORGE BEACH, M.A.,

Co-Author of 'A Manual of our Mother Tongue,' 'A Girls' Arithmetic.' Author of 'Elements of English,' 'Entertaining and Historical Readers,' etc.

I. THE Scholarship Examination will commence on Wednesday, 4th July, 1894. Permission to attend it should be immediately sought; the marks for Repetition, Reading, and Teaching should be secured at next school inspection, and care must be taken that a due entry of the Candidate's intention to sit is inserted in the School Examination 'Form IX.' 'Form XVIII.' must be filled up and returned to the Department before 1st May 1894.

Pupil Teachers who are attempting the Examination for the second time can, most probably, by arrangement with H.M. Inspector, get their Repetition, Reading, and Teaching marks carried on to the 1894 Examination.

Non-Pupil Teacher candidates will recite and read at the Scholarship Examination itself. They will undergo no examination in the actual work of practical teaching.

By this time also a Training College should have been selected. The competition for entrance will be so severe, that in many cases priority of application must decide the selection of the lucky candidate.

In whatever college the candidate may have the slightest degree of influence, that college he should choose in preference to all others, as a feather-weight may incline the balance, and secure for him (or her) the great benefit of college training.

Don't forget the Day Training Colleges.

II. NEW BOOKS.

(i.) '*Honours Physiography,*' by Gregory and Wells, is a most interesting book. All who know the elementary and advanced volumes of this series will expect good work from the authors, and they will have their expectations surpassed.

So clear and attractive is the literary style of the book (even the preface is an excellent specimen of lucid English), that any one possessing only ordinary physiographical knowledge may take up the book as a pleasure and pastime.

Add to this that the work is comprehensive without being bulky, accurate without being pedantic, seductive without being superficial, of great examinational utility without being a cram book, and the manual will not then be over-lauded.

(ii.) *Scholarship Questions with Hints and Solutions.*

The official copies of the questions only for recent years can, of course, be obtained from any scholastic bookseller for sixpence for each series.

Also all the *questions with model answers* are inserted every year in these articles (see issues for August and September).

There are, however, some who would perhaps wish for several years' questions bound together and accompanied by solutions of difficulties.

Such students will be well pleased with a little work published by the National Society, and containing the papers and difficult answers of the last four examinations.

III. MUSIC.

(i.) We have often spoken of the confused and puzzling nomenclature of Music Intervals. Many reputable authors differ in numerous points from each other.

The chief feature of disagreement, however, is whether the

interval shall be named by the actual distance, or the 'paper' distance between the two notes.

Some writers also allow the name of the interval to be affected by the key, whilst other authors do not.

Perfect Octave	C¹	D¹	E¹	F¹	G	A	B	
Major Seventh	B			E¹				
Minor Seventh		C¹	D¹		F	G	A	
Major Sixth	A	B		D	E			
Minor Sixth			C¹			F	G	
Perfect Fifth	G	A	B	C¹	D	E		
Tritone				(1)B			(2)F	
Perfect Fourth	F	G	A		C	D	E	
Major Third	E			A	B_1			
Minor Third		F	G			C	D	
Major Second	D	E		G	A_1	B		
Minor Second			F				C	
	C	D	E	F	G_1	A_1	B_1	

From '*The School Music Review*' (an excellent little monthly magazine, price 1½d., from which we always select our school songs), we extract the following useful and common-sense tables :—

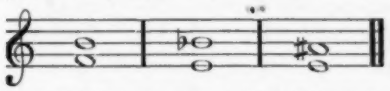
Perfect Octave	d'	r'	m'	f'	s'	l'	t'
Major Seventh	t			m'			
Minor Seventh		d'	r'		f'	s'	l'
Major Sixth	l	t		r'	m'		
Minor Sixth			d'			f'	s'
Perfect Fifth	s	l	t'	d'	r'	m'	
Tritone				(1)t'			(2)f'
Perfect Fourth	f	s	l		d'	r'	m'
Major Third	m			l	t		
Minor Third		f	s			d'	r'
Major Second	r	m		s	l	t	
Minor Second			f				d'
	d	r	m	f	s	l	t

(1) *Tritone*, or Augmented fourth. (2) Diminished fifth.

To interpret the tables, read from the bottom line upwards. Thus, if the name of the interval from $\frac{D}{F}$ be required, take the fourth column where F is the bottom note. It will be seen that the interval is a *Major Sixth*.

The above are generally called *diatonic intervals*, because they may be expressed without employing flats or sharps. The R.A. Music employs this system.

If we reckon (as on an organ) that there are 12 half-tones in an octave, and that each of these are of equal value, then it follows that there can (as far as actual *phonic* distance from one note to another is concerned) only be 12 different kinds of intervals, viz., where the two notes are separated by one, two, three . . . twelve semitones respectively. Thus from F to B and from B to F¹ (each containing six semitones) would be equal intervals, although on paper the former is an augmented fourth, and the latter a diminished fifth. If only *phonic* distance were regarded, the following intervals would all be tritones, but the paper, or staff, distance makes them, *tritone*, *diminished*



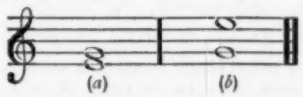
(*or imperfect*) *fifth*, and *augmented* (*or pluperfect*) *fourth respectively*.

Intervals wider than *perfect* or *major* are called *augmented*; and intervals smaller or narrower than *perfect* or *minor* are termed *diminished*. All augmented and all diminished intervals (except the augmented fourth and the diminished fifth) are classed as *chromatic*, because they cannot be expressed in terms of pitch without a chromatic sign or name.

(ii.) Many readers are puzzled by the terms perfect as applied to *octaves*, *fifths*, and *fourths*. Why, they ask with much reason, are the larger *seconds*, *thirds*, *sixths*, *sevenths* denominated *major*, and the remaining larger intervals *perfect*?

There is, however, a convenience in the change of term, **with reference to the results of inversion**, as the following explanation will show.

An interval is said to be inverted when the lower note is raised an octave, whilst the higher note (now the lower) remains fixed in pitch and station. The same effect is produced when the higher note is lowered an octave, whilst the lower note (now the higher) remains fixed.



Here (*a*) and (*b*) are respectively the inversions of one another, (*a*) being a *minor third* and (*b*) a *major sixth*.

To label an interval, two things are required, first its numerical name, second its quality.

In general, the *numerical name* of the inversion can be deduced by subtracting the parent interval from 9. Thus inversions of seconds, thirds, fourths, etc., become sevenths, sixths, fifths, etc.

Also the *quality* of the inversion is usually affected. The inversion of an augmented (or pluperfect) becomes a diminished (or imperfect); the inversion of a major becomes a minor, and *vice versâ*.

Now, if fourths and fifths were called major and minor, this rule would not hold good, for a perfect fifth inverted becomes a perfect fourth, and *vice versâ*. A perfect interval when inverted produces another perfect interval.

Carrying this reason to attenuation, we see why purists speak of *imperfect fifths* and pluperfect fourths, but of *augmented* thirds and *diminished* sixths.

iii. *Major Keys.*

(*a*) When the tonic is raised a perfect fifth, or lowered a perfect fourth, an additional sharp is introduced.

(*b*) When the tonic is raised a major second or lowered a minor seventh two additional sharps are introduced.

(*c*) When the tonic is lowered a perfect fifth or raised a perfect fourth, an additional flat is introduced.

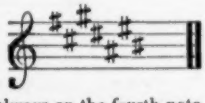
(*d*) When the tonic is lowered a major second or raised a minor seventh, two additional flats are introduced.

(*e*) Sharp keys G, D, A, E, B, F♯, C♯
Flat keys F, B♭, E♭, A♭, D♭, G♭.

(*f*) Note that (α) the letter names of the sharp keys run in reverse order to those of the flat keys.

(β) The new sharp introduced is always on the seventh note of the fresh key, and their order runs F, C, G, D, A, getting into the same arrangement as that of the sharp keys themselves.

(γ) In the staff the sharps and flats must be written in the order of their introduction,

not thus but 

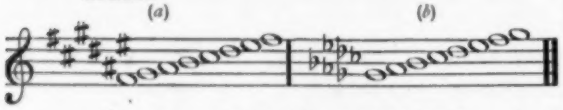
(δ) The new flat introduced is always on the fourth note of the fresh key, and their order runs B, E, A, D, etc., getting into the same arrangement as that of the flat keys themselves.

(ε) The new flat introduced is the tonic of the next flat remove or key.

(ξ) If we reckon the octave composed of 12 equal half-tones, then the key of 3 flats = key of 9 sharps, key of 5 sharps = key of 7 flats. This is well seen in keys of

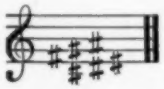
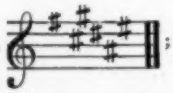
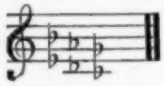
F♯ and G♭, which (according to our convention) are identical, whilst the former has six sharps, and the latter six flats.

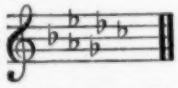
(*a*) (*b*)



Here it cannot help being noted that in the scales of (*a*) and (*b*) the identical notes are played in each case.

(*η*) Somewhat inconsistently with theory, but in accordance with convenience in order to get them upon the staff itself, we do not write

F𝄪, C𝄪, G𝄪, D𝄪, A𝄪, E𝄪, viz.,

but F♮𝄪, C♮𝄪, etc., viz., ;

nor do we write E♭, D♭, C♭, viz., 

but E♮♭, D♮♭, C♮♭, viz., 

Remember that upon these *minutiæ* very many questions have been propounded.

iv. *Minor keys* have the same staff signatures as the major keys whose tones are a minor third above. Thus the minor keys of A, E, B have the same number of sharps in the signature as the major keys of C, G, D, and the minor keys of D, G, C have the same number of flats in the signature as the major keys of F, B♭, E♭, and are said to be their *relative minors* respectively.

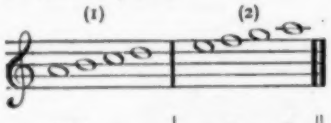
Generally speaking, the minor scale upon a given tonic has three flats more (or three sharps less) in its signature than the major scale upon the same tonic; *e.g.*:

Key.	Signature.		Remark.
	Major.	Minor.	
C	No sharps.	Three flats.	The taking away of a sharp is evidently equal to introducing a flat.
G	One sharp.	Two flats.	
D	Two sharps.	One flat.	
A	Three sharps.	No flat.	
F	One flat.	Four flats.	

The terms *Tonic Major* and *Tonic Minor* are employed to denote keys in the different modes but with the same tonic or keynote.

v. *The Minor Scale.*—Like the Major Scale, the Minor can be divided into two tetrachords.

(1) (2)



l, t, d r | m f s l ‖

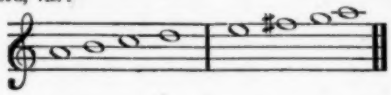
Of these tetrachords the first one is constant in form, except that occasionally the third is sharpened in the final chord of a minor tune, which thus ends with a major instead of a minor chord,* but the second tetrachord is variable.

(*a*) *The lower minor tetrachord.*

This is the essential half of the minor scale, and derives its minor or mournful effect from the position of the semitone between the second and third notes instead of, as in the major, between the third and fourth. In the major the semitone preceding the fourth and eighth gives to these latter notes a firmness and finality requisite for a settled cheerful mode; but in the minor, instead of the tetrachord concluding on the note subsequent to the semitone, it goes on another full tone to an unsatisfied ending, exciting a mental effect similar to sorrowful longings and incompleted desires.

(*b*) *The higher minor tetrachord.*

Undoubtedly this was originally similar to the lower tetrachord, viz.:



l, t, d r | m bah s l ‖

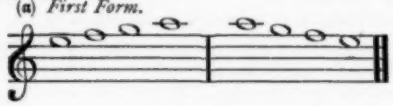
(bah, pronounced bay, is the minor sharp of fah, and is not to be confounded with fe), as researches into the so-called music of savage nations corroborates.

However, it is never used among modern musicians, owing to a growing dislike to the minor mode, and a consequent tendency to assimilate it as much as possible to the major.

Also, as the principles of harmony began to be understood, it was found that even in a minor tune the ear required to be somewhat satisfied at the conclusion, and that to accomplish this a leading-note, only a semitone below the tonic, was requisite.

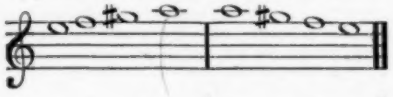
The following three forms of the upper tetrachord are now recognised:

(*α*) *First Form.*



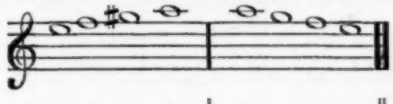
m f s l | l s f m ‖

(*β*) *Second, or Chromatic, Form.*



m f se l | l se f m ‖

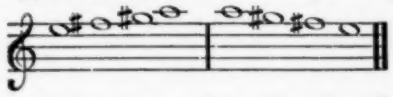
A variation of this form is often allowed in descending:



m f se l | l s f m ‖

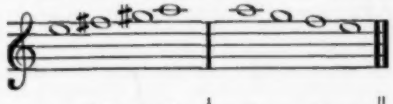
G♯, or se, is called the Major, or essential, or sharpened Seventh; G or S the Minor or occasional Seventh.

(*γ*) *Third Form.*



m bah se l | l se bah m ‖

A variation of this form is often allowed in descending:



m bah se l | l s f m ‖

F♯ is called the Major, or occasional, or sharpened Sixth, and F, or f, the Minor or essential Sixth.

It may be disputed whether this form arose from the primitive and discarded form above mentioned, or whether it originated from Second Form (*β*) on account of that form having a note and a half interval between F and G♯ (f and se).

* The Picard Third, so called from its mediæval use in that province.

Be this as it may, the question is merely of historical, not examinational, interest.

This third form is identical as regards arrangement of its tones and semitone with the upper major tetrachord.

vi. *Tonal names in Minor Mode.*

These follow the practice of the Major Mode, except that of necessity they are in pitch a minor second lower.

A'	- - **l**	- -	Tonic
G♯	- - **se**	- -	Leading-Note.
F	- - **f**	- -	Sub-Mediant.
E	- - **m**	- -	Dominant.
D	- - **r**	- -	Sub-Dominant.
C	- - **d**	- -	Mediant.
B	- - t_1	- -	Super-Tonic.
A	- - l_1	- -	Tonic.

vii. *Typical Questions.*

(*a*) *Staff Notation.*

Write the signatures or scales of—

(1.) F, C, B, C♯ minor keys. (1893.)

(2.) F, B, E, G, B♭, F♯ minor keys. (1892.)

(3.) A♭ major, E major, C minor, G minor. (1890.)

(4.) A major, E♭ major, B minor, F♯ minor, F minor. (1889.)

(5.) B major, A♭ major, F minor, G minor, B minor. (1888.)

(6.) B♭ major, A major, D minor, B minor, C minor. (1887.)

(7.) E♭ major, D major, A♭ major, F minor. (1886.)

(8.) A major, C minor. (1885.)

(9.) E♭ major, B minor. (1884.)

(10.) E major, D minor. (1883.)

(11.) G, D, F, B♭, major keys, E minor and A minor. (1882), (1881).

(12.) What minor keys have in their signatures, 5 flats, 4 flats, 2 flats, 1 sharp, 3 sharps, 5 sharps?

N.B.—*The different forms of the upper tetrachord of the minor mode are repeatedly required.*

(13.) Augmented fifths above G, E, F, A♭, minor sixths above D, F♯, C, G. (1893.)

(14.) Perfect fourths above F, B♭, G (Key D), G (Key E♭); major sixth above G (Key E♭), F♯, F (Key A♭), A (Key E). (1892.)

(15.) Major third above E, G (Key B♭), C (Key D), G (Key E♭); minor sixth above F (Key E♭), A (Key G), D (Key A♭), E (Key E). (1891.)

16.) Major third above B, D, E, B♭. (1889.)

Write below the following intervals their names :—

(17.) B B F' C' / E' D' G♯' G♯. (1890.)

(18.) F' C' B♭ D' / B' D♯' G' F♯ Key E. (1888.)

(19.) A G♯ C'♯ D' / E' F' E E Key E. (1887.)

(20.) C' A E♭ / E' F' C. (1886.)

(21.) B D' C'♯ / F' A' B. (1885.)

(22.) E' C'♯ E'♭ / B♭' F♯' B♭. (1884.)

(23.) B♭ C'♯ D / F' G' B♭. (1883.)

(24.) Re-write $\frac{4}{4}$ passage in $\frac{4}{2}$ time, doubling the value of every note and rest. (1893), (1888).

(25.) Re-write $\frac{4}{2}$ passage in $\frac{4}{4}$ time, halving the value of every note and rest. (1892.)

(26.) Re-write $\frac{3}{4}$ passage in $\frac{3}{8}$ time halving the value of every note and rest. (1891.)

(27.) Complete bars, by adding *one* note, in $\frac{4}{4}$, $\frac{3}{2}$, $\frac{3}{8}$, $\frac{6}{8}$ time. (1887.)

(28.) Complete bars, by adding *one* note, in $\frac{4}{4}$, $\frac{3}{4}$, $\frac{3}{8}$, $\frac{6}{8}$ time. (1886.)

Write time signatures of passages in—

(29.) $\frac{4}{4}$, $\frac{4}{4}$, $\frac{4}{4}$, $\frac{4}{4}$, $\frac{3}{4}$, $\frac{3}{4}$ time. (1885.)

(30.) $\frac{3}{4}$, $\frac{4}{4}$, $\frac{4}{4}$, $\frac{4}{4}$, $\frac{3}{4}$, $\frac{3}{4}$ time. (1884.)

(31.) $\frac{4}{4}$, $\frac{3}{4}$, $\frac{3}{4}$, $\frac{3}{4}$, $\frac{3}{4}$, $\frac{3}{4}$ time. (1883.)

(32.) Similarly we have other passages in $\frac{3}{2}$, $\frac{3}{8}$ and $\frac{6}{8}$ time. (1882), (1881).

(33.) State the key of various passages. (1893), (1892), (1891).

(34.) Explain the meanings of Legato, Dal Segno, Sforzando, Ad libitum, Allegretto, Fortissimo (1893), Pianissimo, Staccato, Mezzo Piano, Forte, Rallentando, Dolce (1892), Adagio, Crescendo, Lente, Accelerando, Ritard (1891), Largo, Andante (1890), Syncopation, Diminuendo (1889), Vivace (1888), ♩ = M. 60 (1887), Da Capo, ♩ = 90 (1886.)

N.B.—The above terms comprise all that have ever been required. All of them have been in repeated request.

(*b*) *Tonic Sol-fa Notation.*

(35.) Write the following values in four-pulse measure—

$\frac{1}{2}$ $\frac{3}{4}$ $\frac{1}{4}$ $1\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{4}$ 1 etc.

s, **f**, t_1, **d**, **r**, **m**, rest, etc. (1893.)

(36.) Write in figures over each note and rest in the following passage its value in pulses, or fractions of a pulse :—Three-pulse measure (1893), Two-pulse (1892).

(37.) Re-write passages, doubling the value of each note and rest :—Two pulse. (1892), (1891), (1890), (1889), (1888), (1887), (1886), (1885), (1884), (1883).

(38.) Re-write passages, halving the value of each note and rest :—Two-pulse. (1892 to 1883.)

(39.) Write the pulse signs for four different kinds of measure. (1891.)

(40.) Write the pulse signs for two-, three-, four-, six-pulse measure. (1890), (1889), (1886), (1885), (1884), (1883), (1882), (1881).

(41.) Describe the measures formed by the following accents :—Secondary Two-pulse, Primary Three-pulse, Primary Six-pulse (1888), Primary Four-pulse, Tertiary Three-pulse, Secondary Two-pulse (1887).

(42.) Describe the intervals formed by the following pairs of notes—

t	**r'**	**ta**	**de'**	**se**	**d'**	**fe**	**l**	(1893),
m	**f**	**s**	**f**	**f**	**m**	**r**	t_1	
m'	**t**	**t**	**f**	**s**	**s**	(1892),
s	**d**	**m**	**se,**	**re**	**de**	
d'	**m'**	**ta**	**d'**	**se**	**f**	(1891),
m	**f**	**r**	**re**	t_1	**de**	
t	**f'**	**t**	**d'**	(1890),
m	**se**	**r**	**se**	
se	**f**	**se**	**f**	(1889),
m	l_1	**r**	s_1	
f	**d'**	**ta**	**ta**	(1888),
t_1	**re**	**s**	**r**	
l	**se**	**de'**	**t**	(1887),
m	**f**	**m**	**d**	

and from 1886 to 1883 an exercise of a similar kind was given.

(43.) If the first note (**l**) of the following passage be **r**, what will the whole passage become? Also if first note be **s**? (1892.) Similarly in 1891, 1882, 1881.

(44.) Re-write a passage, substituting bridge-notes for chromatics (**fe ta** etc.). (1893.)

(45.) Re-arrange the following notes in order of pitch, placing lowest notes first :—**s, t, fe, r' ra, se, d, ta, t, d'**. (1889), (1891).

(46.) Which one of the following notes is highest and which lowest in pitch?—**f** in Key A, **l** in Key G, **s** in Key B♭, **t** in Key C, **l**, in Key A♭, **d** in Key D. (1893), (1892).

(47.) Names of the chromatic notes. (1888), (1887), (1886), (1885).

(48.) Mental effects of the notes. (1884), (1883).

(49.) Relations of the notes in major and also in minor mode, such as Tonic, Supertonic, etc. (1891), (1885).

(50.) Minor scales, especially the forms of the upper tetrachord in 1890 to 1881.

(51.) Musical Terms as for Old Notation, Question 34.

It should be remembered that the marks for Music are more easily obtained than for any other subject, and that no Candidate should anywise omit this Paper.

IV.—Directions for Answering any Test Papers.

No candidate, however well-informed, however industrious, however clever, will do himself justice unless he train himself by repeated examination practice.

At least once a fortnight he should answer a series of questions in Scholarship Examination style, and if he be well-up in his work, once a week is not too frequent.

The following *Rules for Test Examinations* should be observed :—

(*a*) Write on good foolscap paper, as this form is most similar to the Department examination book.

(*b*) Head each paper with name and source of questions.

(*c*) Write only on one side of the paper.

(*d*) Leave a margin of one inch on the left side, and don't write between the lines. In Arithmetic and Algebra this restriction cannot always be strictly observed.

(*e*) Don't write down the question, simply number it in margin.

(*f*) Consider whether a tabulated or literary answer is the better.

(*g*) Illustrate by diagrams wherever possible.

(*h*) As a rule place these diagrams to the N.E. or top right hand.

(*i*) Don't hesitate to use various sorts of, and different sized, characters, or to underline, in order to bring out prominently certain features of your answer. Coloured inks are useful also.

(*j*) Use a red and blue lead for maps. Don't forget the lines of latitude and longitude.

(*k*) Use only the following tools :—Pens, ink (black and red), pencils (black, blue, red), knife, rubber.

(*l*) Don't rule with a black-lead. It is a colourable evasion and may lose marks.

(*m*) Compress your answer as much as is possible without diminishing its literary value. Above all, so arrange it as to correspond with the form of the question, and so that the examiner can see at a glance whether every part of the query has been duly dealt with.

(*n*) In no case merely copy the answer directly from a book. If you can, answer the question without any assistance; if you can't, read up the subject and then after a few hours' interval endeavour to reproduce the information required.

(*o*) Always write well, as the handwriting is assessed from all the papers.

(*p*) Give reasons for your Arithmetical processes and statements, and let the connection between every step be clearly shown.

(*q*) Begin your sentences with different parts of speech.

(*r*) Don't write round and round a question, seeking to mystify the examiner. You can't deceive him, but may make him angry.

(*s*) Use tabular analysis of sentences, according to recently given form.

(*t*) In Parsing, no contraction of less than three letters is allowed.

(*u*) In Euclid almost every sensible abbreviation is allowed, but signs of operations are not admitted. Use printed letters M, N, O, etc., not A, B, C, etc.

(*v*) When you cannot give exact data, resort to approximations which are not incorrect but are only less definite.

(*w*) Don't guess, don't be poetic, don't be funny.

(*x*) Practise your copy-setting on your scrap-paper before you finally write it.

(*y*) Always draw up a rough scheme of your answer.

(*z*) Write against time, don't be leisurely in your Test Examinations.

V.—Note Books.

By this time every reader should have furnished himself with a separate note book for every subject.

These need only be of small size, about equal 20 pp. of foolscap, but of the shape of an ordinary penny memorandum book, in order to facilitate manipulation.

It should not be the object to fill these books. Entries should be made with due discrimination, and no information should be inserted that can be got just as easily from an ordinary text-book.

The entries should comprise—

(*a*) Information not always accessible, as of recent events.

(*b*) Data where to find requisite information.

(*c*) Points requiring special attention on account of individual weakness therein.

(*d*) Points requiring special attention on account of intrinsic importance. See various analyses in 'Practical Teacher.'

(*e*) Sample methods of answering or of arrangement.

(*f*) Hints, wrinkles, catches, miscellaneously gleaned.

(*g*) Practical experience (in the School-Management Note Book).

(*h*) Any difficulties, problems, etc., requiring solution.

(*i*) Some corrections and annotations of answers.

N.B.—Already, as only six months remain, every text-book should have been marked showing portions to be omitted, merely scanned, ordinarily read, or to be carefully studied in future reading.

VI.—We have made arrangements, merely to suit our own readers, and with no desire in the slightest degree to interfere with existing agencies, for tuition based upon these articles, routines, and questions by experienced teachers and graduates.

Names of intending pupils should be sent to Dr. George Beach, M.A., *Stanley Mount, Macclesfield*, from whom further particulars may be obtained.

The fees, to be paid in advance, are 1s. 6d. per week, or 5s. 6d. per month, or 15s. 9d. per quarter, or £1 11s. from present date.

Fortnightly papers at about half the cost can be arranged.

VII.—i. In our Pupil-Teacher Course for this month will be found an account of Matabeleland and Mashonaland, compiled not only from the most recent works, but from the latest lectures by, and documents of, those engaged in the present campaign.

Considering the well-known and natural tendency of the Department to shape their questions by current events, this should be well mastered.

ii. *Sum* 15, *Third Week, November* 1893.

A cottage, which stands upon a square plot of 729 sq. ft., contains four rooms of equal size on the ground floor, and is divided into two equal parts by a passage 4 ft. wide, having two rooms on each side. Allowing one foot for thickness of each wall, find area of each room.

Side of sq. plot $= \sqrt{729}$ sq. ft. $= 27$ ft.

Width of passage and the 4 parallel walls $\Big\}$ $= 8$ ft.

$\therefore$ width of each room $= \frac{27-8}{2}$ ft. $= 9\frac{1}{2}$ ft.

Width of 3 walls at right angles to passage $\Big\}$ $= 3$ ft.

$\therefore$ length of each room $= \frac{27-3}{2}$ ft. $= 12$ ft.

$\therefore$ area of each room $= 12$ ft. $\times 9\frac{1}{2}$ ft. $=$ 114 sq. ft. Ans.

SELECTED GOVERNMENT QUESTIONS.

FIRST YEAR.

First Week.

1. Write in Largehand the word '*Cosmopolitan.*'
Write in Smallhand, '*The world knows nothing of its greatest men.*'

2. Parse this sentence :—

'Even now where Alpine solitudes ascend,
I sit me down a pensive hour to spend.'

3. Draw meridians and parallels for a map of Australia. Sketch the coastline from Brisbane to the mouth of the Murray. Mark the position of Sydney, Melbourne, Adelaide, Perth. Indicate the points where the boundary lines between Queensland and New South Wales, between N. S. Wales and Victoria, between Victoria and South Australia, meet the coast.

4. How are deltas formed? How is it that deltas are common at the mouths of Mediterranean rivers, and absent from the mouths of S. American rivers?

5. Name the chief events in the reign of Charles II., and give the character of that king.

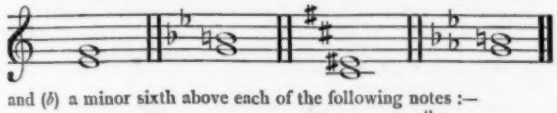
6. Give dates, or approximate dates, and names for the following :—

(*a*) A Statute to check the bestowal of estates in religious foundations.
(*b*) An Act admitting Romanists to Parliament.
(*c*) An Act allowing Nonconforming funerals in churchyards.
(*d*) The Parliament which excluded Bishops from the House of Lords.
(*e*) Treaty which gave Canada to England.

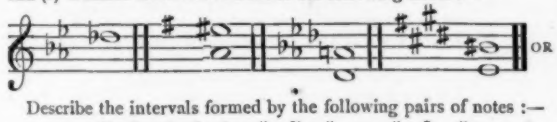
7. What are the advantages and disadvantages of simultaneous reading, and when and how should the practice be adopted?

8. Show by what sort of visible objects and illustrations you could make the rule for the addition of fractions intelligible to a class of beginners.

9. Write (*a*) a major third above each of the following notes :—



and (*b*) a minor sixth above each of the following notes :—



Describe the intervals formed by the following pairs of notes :—

d'	n'	ta	d'	se	f	
n	f	r	re	t_1	de	

10. (*a*) How would you explain to a class beginning fractions the error in the following $-\frac{3}{4}+\frac{2}{7}=\frac{3+2}{4+7}=\frac{5}{11}$?

(*b*) How would you work on the black board and explain to a class (beginning such problems) the following sums? If 7 men can earn £9 9s. in 6 days, how much will 11 men earn in 4 days at the same rate? Ans. £9 18s.

11. Simplify 2·749 of ·25$\dot{4}$ of ·190476 of £2 10s. Ans. 6s. 8d.

12. (*Men only.*) Write out Euclid I. 8.
PQR is a triangle, right-angled at P, S is a point in PR, T is a point in PQ. Prove by (I. 47) that the sum of the squares on RT, SQ is equal to the sum of the squares on QR, ST.

(*Women only.*) Give the reasons for and against the use of a sewing machine in a household.

13. (*Men only.*) If x^2+ax+b and x^2+cx+d have a common measure of the form $x+e$, show that $e=\frac{b-d}{a-c}$.

(*Women only.*) Describe the modes of washing, drying, and getting up the different articles which would go into the tub on washing day in a labourer's cottage.

14. (*Men only.*) (*a*) Multiply $1-x^2+x^4-x^6$ by $1+x^2$.
Ans. $1-x^8$.

(*b*) Divide $x^4+\frac{2}{3}x^3+\frac{21}{8}x^2+\frac{23}{16}x+\frac{5}{16}$ by $x^2+\frac{3x}{2}+\frac{1}{4}$.
Ans. $x^2+\frac{5}{6}x+\frac{5}{4}$.

(*Women only.*) What are the chief points to be considered before investing in building societies? What are the benefits offered by such societies, and the results to be obtained when such investments are secure?

15. (*Men only.*) The three sides of a triangle are in the ratio 4 : 5 : 7, and their sum equals 32 yards. Find the area of the triangle in yards to two places of decimals. Ans. 39·19 sq. yds.

(*Women only.*) What stitches would you require in making the sleeve of a man's shirt? Explain any two of them as you would to children.

16. Translate into English :—Hélas! *lui* répondit son père en *versant* des larmes, crois tu, pauvre *enfant*, que *l'on puisse parler* à l'empereur comme tu parles à ton père en Sibérie? Des sentinelles gardent de toutes parts les avenues de son palais, et tu ne *pourras* jamais *en passer* le seuil. Pauvre et *mendiante*, sans habits, sans recommendations, comment oseras-tu paraître, et *qui* daignera te présenter?

17. Parse the italicised words of the above passage.

Second Week.

1. Analyse the following passage :—

'As in a theatre the eyes of men,
After a well-graced actor leaves the stage,
Are idly bent on him that enters next,
Thinking his prattle to be tedious;
Even so, or with much more contempt, men's eyes
Did scowl on Richard. No man cried "God save him."
No joyful tongue gave him his welcome home.'

2. Explain the meaning of each of these terms, and make sentences illustrative of their use :—*Passive, Antithesis, Infinitive of Purpose, Co-ordinate, Demonstrative, Apposition, Ellipsis.*

3. Mention six of the greatest engineering works in the world, giving what particulars you can respecting them.

4. Draw a diagram of the planetary system, and give the principal statistics thereto relating.

5. Explain the circumstances which led to the Norman Conquest, and briefly describe the battle of Hastings.

6. What events and persons are referred to in the following quotations? Give dates :—

(*a*) 'Oh, father abbot,
An old man, broken with the storms of state,
Is come to lay his weary bones among you.'

(*b*) 'Twas when his banners at Boulogne
Armed in our island every freeman.'

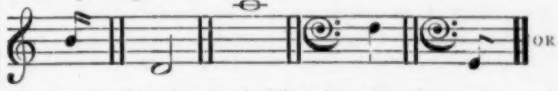
(*c*) 'The country maid
Who set her country free, and passed in fire.'

(*d*) 'The sweetest of all music
The pipes at Lucknow played.'

7. In giving a lesson on a River, which is the better plan, to speak first of a particular River which the children have seen, or to start with a definition and a general description? Give reasons for your opinion.

8. Describe the best method of proceeding in teaching a new song to infants or to older children.

9. Write the pitch names (C, B, etc.) and the duration names (crotchet, etc.) of the following notes, and write the signs for rests of corresponding value :—



Re-write the following, (1) doubling the value of every note and rest, and (2) again, halving the value of every note and rest :—

s	:—	|	:r	|	n	:-	.d	|	r	.d	:t_1	.d	‖			

10. Find the least common multiple of 12, 64, 80, 96, 120, and 160. Ans. 960.

11. The area of a county is 304,629 acres, and the population 207,129; find to the nearest integer the number of persons per square mile. Ans. 333.

12. (*Men only.*) Write out Euclid II., 2.
A, B, C are three given points. Through A draw a line such that the perpendiculars upon it from B, C may be equal.

(*Women only.*) Describe, as fully as you can, the origin, preparation, and use of the two principal vegetable products used in this country for clothing.

13. (*Men only.*) If $\frac{a}{b} = \frac{c}{d}$, show that $\frac{a+b}{a-b} = \frac{c+d}{c-d}$

(*Women only.*) Give an account of the price, material, colour, and making-up of a neat dress for your own summer wear in school, and say how it should be washed and worn so as to last as long as possible.

14. (*Men only.*) (*a*) Define the terms *factor*, *coefficient*, *power*, *index*, *binomial*, and explain the use of brackets.

(*b*) Simplify the expression $(2a - \{3b - \overline{a - c}\} + \{4b - \overline{3a - c}\})$.
Ans. b.

(*Women only.*) Mention the kinds of animal food in common use in England, and state the position which each holds as regards nutrition and ease of digestion, and give your reasons.

15. (*Men only.*) Compare the area of a square inscribed in a circle with that of the circumscribed equilateral triangle.
Ans. As $2 : 3\sqrt{3}$.

(*Women only.*) What are the needlework requirements of the Code for Standard III.?

16. Write out a list of the Judges, and describe the doings of Jephthah.

17. 'What did your Godfathers and Godmothers then for you?' Give the answer with illustrative proofs from Scripture.

Third Week.

1. Write from Dictation the following passage :—

'It is evident, | that whatever inspires feelings of terror, | or of great wonder, | and whatever excites in the mind | an idea | of the vague and uncontrollable, | has a special tendency | to inflame the imagination, | and bring under its dominion | the slower and more deliberate operations | of the understanding. | In such cases, | man, | contrasting himself | with the force and majesty of nature, | becomes painfully conscious | of his own insignificance. | A sense of inferiority | steals over him. | From every quarter | innumerable obstacles hem him in, | and limit his individual will. | His mind | appalled by the indefined | and indefinable, | hardly cares | to scrutinize the details | of which | such imposing grandeur consists.

2. Name the chief writings of the following authors :—Ben Jonson, Dryden, Addison, Gibbon, and Scott.

3. In what parts of the world beyond Europe are these languages spoken :—*English*, *French*, *Spanish*, *Dutch*?

4. What difference can you observe (*a*) Between the position of the sun when it is rising in December and its position at sunrise in June? (*b*) Between its position at noon in December and June?

5. What reigns are most remarkable for an increase in the powers of Parliament? Compare the Parliaments of Henry VIII. and of Charles II.

6. State briefly of each of the following :—(*a*) When he lived; (*b*) with what political or social questions his name is associated :—Milton, Locke, Hume, Clarendon, Burnet, Cobden, Dr. Arnold, Howard.

7. Give some examples of exercises in mental arithmetic suitable for the highest class in a school, and show by what means rapidity and accuracy can be best secured in conducting such exercises.

8. What are the advantages and disadvantages, if any, of encouraging the scholars to put their own questions at the end of a lesson?

9. Explain the following terms :—*Largo*, *Andante*, *Pianissimo*, *Crescendo*, and give the Italian equivalents of their opposites.

10. Four men can walk 105, 112, 126, and 168 miles in a week respectively; what is the least distance they can all walk in an exact number of weeks? Ans. 5,040 miles.

11. The sum of two numbers is $5\frac{3}{8}$: the smaller is $2\frac{7}{12}$, what is the greater? Ans. $2\frac{11}{24}$.

12. (*Men only.*) Write out Euclid I., 13. Define parallel straight lines.

A is a point without the angle C B D. Draw from A a straight line A E F, cutting B C in E, B D in F, so that A E may be equal to E F.

(*Women only.*) The food stuffs on which man subsists may be divided into two well-marked groups, nitrogenous and non-nitrogenous. Explain what this means, and why these terms are used.

13. (*Men only.*) If $a + b + c = o$, show that $a^4 + b^4 + c^4 = 2(ab + bc + ca)^2$.

(*Women only.*) Mention any respects in which the modern fashion of female dress is injurious to health, and show in what way each foolish practice produces its bad results.

14. (*Men only.*) Find the G.C.M. and L.C.M. of $x^2 + 5x + 4$; $x^3 + 4x^2 - 2x - 8$. Ans. $x + 4$; $(x + 1)(x + 4)(x^2 - 2)$.

(*Women only.*) What are the special functions of (*a*) water, (*b*) albumen, (*c*) sugar, (*d*) fat, (*e*) salt, as food?

15. (*Men only.*) A rectangular park, one side of which is twice as long as the other, contains 500 acres. How much ground will be occupied by a road 15 feet wide running round it?
Ans. 6a. 3r. 14p. $6\frac{1}{2}$ sq. yds.

(*Women only.*) What amount of coloured print is required for a child's frock (age of girl twelve years)? Mention any other materials, with the cost, and the quantity wanted to complete a dress.

16. Translate into English :—

Pendant un de ces violents orages qui sont très fréquents dans ces contrées, les bateliers, *voulant* éloigner la barque *du* rivage, poussèrent avec force une grande rame, *qui servait de gouvernail*, du côté *où* plusieurs personnes étaient assises sur le bord du bateau, et n'eurent *plus* le temps de la retirer; trois passagers, au nombre *desquels* étaient Prascovie, *furent renverses* dans le fleuve.

17. Parse the italicised words of the above passage.

Fourth Week.

1. Select from the two extracts given in Question 1 of second and third weeks, any words which you know to be of Latin origin, and give the roots of any six of them, with examples of other words having the same derivation. Choose also six purely English words, and say how you recognise them.

2. Correct, if necessary, any of the following sentences, and give your reasons :—

(*a*) How sweet the moonlight sleeps upon this bank!
(*b*) I am sorry to differ with you.
(*c*) He is averse to the proposal.
(*d*) For thou art a girl as much brighter than her,
As he is a poet sublimer than me.
(*e*) These are the two persons whom he thought were far away.
(*f*) This England never did, nor never shall,
Lie at the proud foot of a conqueror.

3. Give some account of the advantages of the position of London for (*a*) the capital of England, (*b*) a centre of international trade. By what railway routes could you travel (*a*) from London to Plymouth; (*b*) from Manchester to London?

4. Write down the countries, capitals, and chief ports of South America. What is the nature of their governments?

5. State any facts you know relating to the foreign policy of Oliver Cromwell and Charles II. respectively.

6. State briefly, giving date, some facts of historical importance in connection with Monasteries, Universities, The Poor Laws, The National Debt, Bank of England, East India Company, Negro Slavery.

7. After explaining to a class the effect of mountain ranges upon climate, show how you might lead the children to seek further proofs for themselves.

8. What is an Object Lesson? Show that mere sight is not necessarily knowledge.

9. Write the signature and descending scale of G minor, using the minor seventh and the minor sixth : or
Write a descending minor scale (*lah* mode) using the minor, or occasional, seventh, and the minor, or essential, sixth.

10. Simplify :—
$$\frac{(1\frac{7}{8} - 3\frac{1}{4}) \text{ of } (\frac{4}{3} - \frac{3}{10})}{\frac{5}{6} + \frac{1}{2} - \frac{13}{14}}.$$
Ans. $10\frac{488}{1001}$.

11. If 56 acres, 2 roods, 21 poles, cost £3,899 2s. 0d., how much will 17 acres, 3 roods, 33 poles, cost at the same rate?
Ans. £1,236 6s. 0d.

SCHOLARSHIP OR FOURTH YEAR ROUTINE FOR JANUARY, 1894. (MEN AND WOMEN.)

FIRST WEEK	DAYS	SECOND WEEK			THIRD WEEK			FOURTH WEEK		
		I.	II.	III.	I.	II.	III.	I.	II.	III.
HOLIDAYS.	MONDAY	Simultaneous Equations of the First Degree *or* Ingredients of Food	Dates from 1848 to 1867	Latin *or* French Grammar	Quadratic Equations *or* Rules of Health	England under the Stuarts	Chapters 45 to 50 of 'De Bello Gallico' *or* pp. 57 to 66 of 'La Jeune Sibérienne'	Problems involving Quadratic Equations *or* Any Revision	Lives of Great Men	Latin *or* French Grammar
	TUESDAY	Props. 7 to 14 of Euclid, Book II., *or* Patterns of Boy's Shirt and Woman's Nightgown	Geography of Polynesia	Science *or* Revision	Props. 1 to 7 of Euclid, Book II., *or* Patches	Latitude and Longitude	Science *or* Revision	Props. 27 to 48 of Euclid, Book I., *or* Patches	Winds and Currents	Science *or* Revision
	WEDNESDAY	'Division into Proportional Parts	Music. All the Major Scales and Signatures *or* First Removes of Key. Bridge Notes	Drawing *or* Revision	Compound Interest	Composition on 'The Utility of Rivers'	Drawing *or* Revision	Miscellaneous Arithmetic	Repetition and Literature *or* Writing	Drawing *or* Science
	THURSDAY	Problems leading to Simultaneous Equations of the First Degree *or* Any Needlework	England under the Tudors	Notes of a Lesson on Writing to Standard II.	Quadratic Equations *or* Miscellaneous Arithmetic	England under the Stuarts	Latin *or* French Grammar	Problems involving Quadratic Equations *or* Any Revision	Lives of Great Men	Chapters 45 to 50 of 'De Bello Gallico' *or* pp. 66 to end of 'La Jeune Sibérienne'
	FRIDAY	Props. 33 to 48 of Euclid, Book I., *or* Flannel Sampler	Map of United States	Science *or* Revision	Props. 1 to 26 of Euclid, Book I., *or* Diagram of Chemise	Physical Geography of Mountains and Rivers.	Vocal Music	Any Book I. Deductions *or* Diagram of Night Shirt	Map of Australia	Science *or* Drawing
	SATURDAY	Mensuration of Parallelograms *or* Problems of Motion	Greek Prefixes and Affixes	Examination	Mensuration of Triangles *or* Simple Interest	Notes of an Object Lesson	Examination	Mensuration of Irregular Figures *or* Compound Practice	Music. Dotted Notes, Tied Notes, Semiquavers, Triplets, *or* Six and Nine-pulse Measures	Examination

12. (*Men only.*) Write out Euclid II., 3.

PQRS is a rectangle, T any point; show that the squares on TP, TR are together equal to the squares on TQ, TS.

(*Women only.*) Two teachers live together in the country and have their washing-day once a fortnight. Describe how they would manage with the help of a girl of 14, remembering that their school duties must not be neglected.

13. (*Men only.*) (*a*) Divide $x^3 - 5x^2 - x + 14$ by $x^2 - 3x - 7$. Ans. $x - 2$.

(*b*) Divide $x^2 - (a + b)x + ab$ by $x - b$. Ans. $x - a$.

(*Women only.*) Describe very fully the process of making bread, and the differences of method necessary to suit the kind of oven used in the process.

14. (*Men only.*) (*a*) Prove the formula $a^m \times a^n = a^{m+n}$.

(*b*) Simplify $\frac{2}{x+y} + \frac{2}{x-y} - \frac{4x}{x^2+y^2} + \frac{4y}{x^2-y^2}$.

Ans. $\frac{4y(x+y)}{(x-y)(x^2+y_2)}$.

(*Women only.*) Describe fully the injuries done to health by neglect of personal cleanliness.

15. (*Men only.*) A schoolroom is 60 ft. long, 20 ft. broad, 10 ft. high to the wall plate, 16 ft. high to the ridge of the roof. How many children would it contain, allowing 80 ft. of cubic space for each child? By how much does this exceed the workable number at 8 sq. ft. per child? Ans. 195; 45 children.

(*Women only.*) Write out rules for making a baby's sock.

16. Write out a list of the parables recorded in St. Matthew.

17. What is the use of the introductory sentences and exhortation? What scriptural warrant is there for their insertion in a form of prayer?

(*For Correspondence see end of 'Our 1894 Certificate Class.'*)

WELL-KNOWN TEACHERS AT WORK.

XXV.—MR. R. LISHMAN,

Head Master, Belle Vue Higher Grade School, Bradford.

The subject of our present sketch occupies a unique position in the town in which, for the last sixteen years, he has exercised the duties of his profession. Taking no narrow view of the position and the responsibility of a Teacher, Mr. Lishman's influence extends far beyond the walls of his school. Bringing to bear on educational matters a singularly keen and independent mind, his advice and counsel are eagerly sought for and prized by his colleagues, and by all who take an interest in education. As an ardent Unionist, Mr. Lishman has impressed the stamp of his own vigorous and independent personality on the Bradford Teachers' Association. This large and important branch of the National Union of Teachers has for some years past not only taken the lead in bringing to the front questions of deep interest to Teachers of this country, but has initiated educational movements within its own district, and has acquired an influence which has contributed in no mean degree to the present high position Bradford occupies as a community progressive in matters educational. A great deal of the credit for this is due to Mr. Lishman's initiative. As a social reformer and a politician, Mr. Lishman has acquired great influence with the working classes of the worsted town.

Belle Vue Higher Grade Board School is a handsome stone building situated in one of the best residential quarters of Bradford. It consists of four departments, an Infants' School, Junior Mixed School, and departments for the upper Standards of boys and girls respectively. The accommodation in the boys' departments is for 436 scholars of Standard III. and upwards (of whom 100 are Standard VII. and Ex.-Standard VII. scholars), but it has long been overcrowded, and a new school is shortly to be built for 800 boys, the present boys' department to be added to the accommodation of the Higher Grade Girls' School. It is decidedly to the credit of the Bradford School Board, as a practical body, that Mr. Lishman was asked to attend the Sites and Buildings Committee, and consulted as to the details of the new school. Our friend did not get all he asked for, as he would have liked to have seen a swimming bath included in the plans for the new school, but this the Board did not see their way to grant. The ventilation of the new school is having proper importance attached to it. A gas engine will be fixed in the basement to drive a ventilating fan, and the Board estimate £600 as the cost of the arrangements they are making for a supply of pure air to the scholars of the new school.

The present boys' department consists of one large room, occupied by four classes, five class-rooms, science lecture-room, and room for manual work.

We spent a morning at the school in company with Mr. Lishman. Entering the Teachers' room, our attention was arrested by a monthly syllabus of work for all the Teachers. As in most of the Bradford schools, the boys march in from the playground to the strains of the piano, at which one of the scholars officiated. Assembled in the large room, an anthem in several parts is very tastefully and tunefully sung, after which the various classes file off to their respective rooms. In a conspicuous position on the wall at the back of the Head Master's table is a handsome Challenge Shield given for competition to the Bradford Board Schools, and of which the Belle Vue boys are the proud possessors. By the side of it hangs a portrait of the winning team. We congratulated our host on the success of his school in sports.

'Yes,' was the reply, 'I feel as proud of the possession of that trophy as I do of any success my boys have attained in their studies. Bradford folks, as you know, are keen critics of football and cricket playing, and the way in which some of our little fellows play quite excited the enthusiasm of the oldsters who watched them. I am a strong believer in physical exercises. You cannot get good work out of children whose physique is inferior, and, despite some exceptions to the contrary, success in life cannot be gained by weaklings.'

Under Mr. Lishman's guidance we go through the various rooms, which are all lofty and well-lighted. The pitch-pine panelling, which is a feature of the Bradford schools, gives a warm and homelike appearance to the rooms.

We particularly admired the science lecture-room, which is undoubtedly the best room in the building. The seats are arranged on a gallery, so that every student gets a good view of what is going on at the lecturer's table.

'Let me tell you,' says Mr. Lishman, 'a little incident connected with the building of this room, which shows how far we have advanced in educational matters of late years. When this school was

built, the Government of the day would not lend the School Board the money to build this room. The Board had consequently to borrow the necessary money in the open market.'

As one would naturally expect to be the case, the children are of a class superior to that attending the ordinary Board School. Not that there are no children of poor parents in the school. The School Board has at its disposition a large number of Scholarships from the ordinary Board Schools to the Higher Grade Schools, and the competition for these is keen.

The school is liberally furnished, and, by comparison, very well staffed. There are ten assistants, all certificated, and several possessing University distinctions.

'What does the curriculum of your school embrace?' we ask.

'In addition to the ordinary subjects, we take English and geography throughout as class subjects. We take Sound, Light and Heat, and Chemistry, as specific subjects. French and algebra are taught from Standard IV. upward, and shorthand and book-keeping to boys who have passed Standard VII. In addition, Standards VII. and Ex.-VII. take plane and solid geometry, mathematics (the first two stages), acoustics, light and heat, electricity, and inorganic chemistry for the Science and Art Department. This year, for the first time, a number of boys are going in for the Cambridge Local Examinations.'

'Your teaching, then, develops mainly in a scientific direction?'

'Yes. I am a strong believer in the intellectual advantages of scientific as opposed to mere literary training. But science teaching must be experimental and practical, so that children may acquire knowledge in Nature's way, by the exercise of the faculty of observation.'

Yours faithfully
R. Lishman

That Mr. Lishman carries out his ideas of what science teaching should be is made clear by the two reports which follow. The first is from an Inspector of the Science and Art Department, who paid the school a visit without notice.

'One of the best taught classes I have visited. The teacher knows what will suit boys in these Standards, and teaches to perfection. He was treating of carbon dioxide with well-arranged experiments. The lecture-room is a model of what School Boards, desiring to promote technical instruction, should aim at.'

The second report is from Her Majesty's Inspector of the District (Mr. T. G. Rooper), himself an educationist of the first water.

'I witnessed two lessons (by the Head Master), one in chemistry and one in physics, and the care with which the boys were made to follow the experiments, step by step, and the reasoning depending on each step, left nothing to be desired. The Board ought not to be content with any science teaching which is not of this character.'

During the comparatively short existence of Belle Vue Higher Grade Board School 84 boys have won Scholarships to the Bradford Technical College, 47 to the Bradford Grammar School, and six have won other Scholarships. In the present year, 11 out of 27 Bradford Grammar School Scholarships were won by Belle Vue boys. Seven old boys have obtained the Associateship of the Royal College of Science. Six of the seven are now in residence there. Another old boy is Lecturer on Metallurgy and Geology in the Sheffield Technical College. Another—Mr. Lishman's oldest son—is Science Demonstrator to the Bradford School Board. One of the Demonstrators in Physics at the Royal College of Science is an old Belle Vue boy. An Exhibition at the London Matriculation Examination fell to an old pupil of this school, while another passed the same examination in the First Division. At the older Universities Belle Vue boys have also distinguished themselves. Two Scholarships at Oxford of the value of £90 each per annum, an open Classical Scholarship and Hastings Exhibition, a Natural Science Scholarship at St. John's College, Cambridge, a Science Demyship at Magdalen College, Oxford, of the value of £80 per annum, and two Salt Scholarships of the value of £30 each per annum, have all been won by old boys of Mr. Lishman's school.

From the last Science Blue Book we learn that the total Science Grants to Belle Vue School were £383 10s., an amount only exceeded by one other institution in Bradford—the magnificent Technical College, which will be remembered by all who attended the Easter Conference in 1886.

In consequence of the large grants the school earns, it is not only carried on without cost to the rates, but a balance in hand is left.

It goes without saying that the school always does excellently well in the examinations of the Educa-

tion Department. This year, in fact, the school was excused examination on account of its excellence.

After jotting down the above facts, we remind our host that the readers of this paper would like to know something of his opinions on matters affecting the profession. We remind Mr. Lishman of the brilliant and incisive Presidential address he read when he assumed the Chair of the Bradford Teachers' Association, an address which had much to do with the shaping of our own opinions.

'I have not seen occasion to alter the opinion I expressed then, that the theorists who rule us at the Education Department and on School Boards are the greatest obstacles to educational development which can exist.'

On another point we found our host holding an opinion unfavourable to one of the objects of our Union. We quote his exact words:—

'I heartily detest the demand of Teachers that they shall be recognised as a profession, like the legal and medical professions. The legalised monopoly which these closed professions exercise is a survival from the Middle Ages. Ours is a modern profession, and should be regulated in accordance with modern ideas.'

This disagreement with one of the articles in the Union's creed does not prevent Mr. Lishman being a strong Unionist. He joined the Union immediately on leaving College. In the Bradford Association he has held every office except that of treasurer. This model Association may be said to have solved a problem which vexes many of the branches of the National Union. Well-attended meetings are the rule, not the exception, with the Bradford Association. The Inspectors of the Bradford District show their interest in the work of the Association by attending its meetings, and reading papers on subjects of pedagogic interest. When the subject of Manual Instruction came prominently to the front, the Bradford Association established Sloyd classes for Teachers, of which Mr. Lishman became Secretary. A Swedish lady was appointed Teacher, and a grant of £100 was made by the Bradford Town Council to the support of the classes, out of the money coming to it under the Technical Instruction Act. These classes remained in full vigour until they were taken over by the Bradford School Board.

Mr. Lishman holds strong opinions in favour of the federation of Teachers' Associations with other Unions of workers. The Bradford Teachers' Association passed a resolution, moved by him, in favour of the Teachers' Association affiliating itself to the local Trades Council, but the Executive refused to sanction this step being taken.

Holding, as he does, the opinion quoted above, that the rule of theorists stands in the way of educational progress, Mr. Lishman actively supported the taking of a bold step at the last election for the Bradford School Board. This was nothing less than to run a most popular and able Board School Teacher as a candidate for the School Board. Not only so, but the Teachers determined to pay their candidate if he were elected. The Bradford School Board Teachers' Electoral Association was formed. Of the Executive of this Association Mr. Lishman was appointed Chairman. Twenty Head Teachers signed a legal document guaranteeing to pay their candidate, Mr. Boyle, £150 per year for three years if he were elected. The result of the election was a magnificent triumph for the Teachers, Mr. Boyle being placed at the head of the poll. It is creditable to the Bradford Teachers to find that they have not allowed their twenty self-sacrificing colleagues to bear alone the burden of Mr. Boyle's salary. Over 85 per cent. of the Teachers contribute to the fund, which produces more than £150 per year, and which is in such a prosperous state as to enable an additional sum for travelling expenses to be voted to Mr. Boyle.

We have yet to notice Mr. Lishman's connection with the labour organisations of Bradford. To us, who have known Mr. Lishman for so many years, it was no surprise to find him among the foremost in advocating publicly the improvement of the condition of the working classes; and when we suggested to him that the readers of the 'PRACTICAL TEACHER' would be interested in knowing by what steps he had been led to take his present position on social and political matters, we found him quite ready to give the information we asked for. We quote Mr. Lishman's words:—

'I have always considered that, being the educators of the children of the working classes, their ideals should be ours, and our sympathies should be with them. It happened that a deputation of working men, representing various trades and debating

societies, waited on the Teachers' Association, asking if some of our body would volunteer to give them lectures on interesting subjects. Eight Teachers, of whom I was one, volunteered to give the lectures asked for.'

'Where were the lectures given?' we ask.

'Some were given in the schools, but wherever we found it difficult to get a good congregation in a school, we did not hesitate to go where the working man would be found, and to seek him in the hours when he had most leisure. The majority of the lectures were given on Sunday evenings, in the parlours of taverns. I could not undertake to say at the present time exactly how many times I gave my lecture on the "Chemistry of a Candle." The times ran into dozens.'

'The greater acquaintance with the working classes which I thus obtained led me to review my own opinions. The Socialistic opinions I continually heard expressed by my working-class friends led me to a study of the literature of Socialism, and I eventually became a Socialist of the Fabian type.'

And here, lest any of our readers should think Mr. Lishman to in any way resemble the ranting demagogue whom we have seen caricatured in the comic journals and on the stage, we hasten to say that nothing could be further from the case.

Always neatly and quietly dressed, courteous in manners and reposeful in bearing, Mr. Lishman is the master of a quiet, persuasive, and passionless style of oratory which appeals to the head rather than to the heart. So far from flattering the passions of his working-class audiences, Mr. Lishman endeavours to lead them by argument, and to get them to look at social and political questions from the broad platform of public utility.

Mr. Lishman has spared no efforts to induce working men to study political questions. He is fond of taking up standard works on Economics, and giving courses of lectures on them at the Working Men's Clubs. Among other works which he has thus treated in detail are Ruskin's 'Unto this Last,' Henry George's 'Progress and Poverty,' Gibben's 'Industrial History of England,' and several publications of the Fabian Society.

Mr. Lishman has thrown in his lot with the new Independent Labour Party, and is President of the Manningham Independent Labour Club, and member of the Central Executive of the Party. He is an active propagandist and open-air speaker. At the last May Day Demonstration at Shipley Glen, Mr. Lishman was one of the speakers.

We could not help putting to Mr. Lishman a question which would naturally occur to one who knows the conditions under which Teachers work.

'Have you ever got into any trouble with our managers in connection with your political work?'

'Not in the least,' was the reply. 'I believe rather in Teachers exercising the rights of free citizens than in putting forth a claim to exercise those rights.'

It could not have been better put. After all it is difficult to attack a man who simply and courageously exercises the rights and privileges which he has been taught to regard as one of the dearest heritages of a British citizen.

'The earnest North' claims Mr. Lishman as one of her sons. He served his apprenticeship at the Stephenson Memorial School, Willington-on-Tyne, under Mr. Alfred Goddard, the genial and popular Clerk of the Newcastle-on-Tyne School Board. He was trained at Borough Road, which he left to take the Head-Mastership of the British School, New Radford, Notts. On the incorporation of New Radford in the Borough of Nottingham, Mr. Lishman's school was transferred to the Nottingham School Board. In 1877 Mr. Lishman opened the temporary Higher Board School at Greenfield School, Lumb Lane, Bradford. The school was removed to the present permanent building in 1879.

Mr. Lishman has passed the Intermediate Science Examination of London University. He is not unknown as an author. His 'Concrete Arithmetics' have had, and still have, a very large sale. In conjunction with the Head-Mistress of Belle Vue Higher Grade Girls' School he has lately brought out a very useful work, entitled 'Experimental Science as a Class Subject.'

We have not thought it necessary to apologize in any way for giving a sketch of Mr. Lishman's political work, as well as of his work as a Teacher. The readers of the 'PRACTICAL TEACHER' who do not sympathise with the political opinions he holds will, we are confident, feel proud of Mr. Lishman as one who successfully carries into practice the liberty that every Teacher in theory enjoys.

PAPERS FOR PUPIL TEACHERS.

BY JOHN ADAMS, M.A., B.SC., F.C.P., ETC.
Principal, Free Church Training College, Aberdeen.

ARE TEACHERS OF ANY USE?

I DARESAY you think this a very silly question: 'Are teachers of any use?' and wonder why in the world anybody ever thought of putting it. But when you grow older and read more books you will find that quite a number of great writers think that teachers are not only of no use, but are a cause of positive evil.

Some of these writers are only ill-natured, and haven't thought much about the matter at all. They think it is smart to write as Blake (a poet and painter about the beginning of this century) did:—

> 'Thank God I never was sent to school,
> To be flogged into following the style of a fool.'

But other writers have thought out the subject, and have come to the serious conclusion that teachers only hinder their pupils, instead of helping them. 'How many distinguished men,' asks a great French author, 'have been entirely self-educated, and are only the better for it!' To be sure, this is not a fair argument, for self-educated men are always men of exceptionally strong character, who are really successful in spite of, not because of, their imperfect training. All the same, this argument is very popular—perhaps because it is founded upon fact, though not the fact that writers usually think.

For I have a great secret to tell you this month—a secret so important that I hope the printer will see his way to put it into capitals. If we understand

teaching to be what is usually meant in such expressions as 'I teach French,' or 'I shall teach you to write Shorthand,' *then*—

No Teacher can Teach!

This isn't very encouraging for young teachers, but, young as you are, you are old enough to know that all such startling statements are only made to be explained away. In one way they are true, in another false. In this case the statement simply means that all education must be self-education.

In newspaper advertisements we read every now and then: 'Every man his own carpenter'; 'Every man his own lawyer'; and so on. Usually when every man tries to be his own lawyer or doctor he makes an uncommonly poor job of it: but in sober earnest every man, whether he will or not, *must* be his own teacher.

One of my old masters had a saying which he seemed to regard as a joke, but at which we could never raise a laugh. When he gave us a particularly hard task he would say he was sorry, but he couldn't learn it for us. It was true, obviously true, almost impudently true. But it was true in that vague, far-off way that so many things are true: it was true without being real to us. To the teacher it must not only be admitted to be true, it must be acted on.

How often do you find a P.T. 'explaining' some difficulty by repeating the rule. He writes a concrete example on the board, then gives the abstract rule to work it. The child does not understand it, so the P.T. repeats the rule—only he says it louder this time. For just as we all think that a Frenchman is bound to understand English if only we speak it loud enough, so, many teachers seem to think that intelligence must increase with the pitch of the voice. After much honest shouting the teacher gives up the attempt, and sets down the pupil as stupid; the fact being that he has simply been asking the child the one question: 'Do you understand this question?' all the time.

This is what the French educationist, Jacotot (1770–1840), means, when he says that most schoolmasters go through the world doing nothing else but wringing their hands and saying: 'Don't you see? Don't you see?' But we can wander far enough, if we only keep to theories. Already, I am sure, you are impatient to know what you are to do, since you cannot learn for another.

To begin with, we must find out the meaning of the word 'to teach.' To tell you all that this verb does *not* mean would take a whole article for itself, so I shall come to the point at once and say that for practical purposes it means 'Causing another to know.' You will notice that the 'knowing' is to be done by the other fellow; we confine ourselves to the 'causing.'

At once you come out with the very pointed question: '*How?*' The practical answer that most pupil-teachers give to this is: 'Tell the pupil over and over again till he knows.' This is at the bottom of the general condemnation of 'telling' in teaching. Now, there is a place for 'telling' in teaching, but that place is not where something has to be explained by giving a complete cut-and-dry statement. The mind must be prepared for the telling, and the telling must be prepared for the mind. The mind must be got into a state in which it desires knowledge, and the telling must be so arranged that complex facts are presented bit by bit in their simple state, then gradually combined as they are grouped by the mind.

One way of preparing the mind was suggested by Rousseau (1712–1778). It consisted in leaving the mind quite to itself. The teacher was simply to stand by and answer questions; the positions were to be reversed, and the teacher was to play the part of the good little boy who only speaks when he is spoken to. This is the very best method of educating children who are perfect by nature.

This and other fancy methods are of no use in our schools; you still want to know what you are to do in your school to-morrow, where there are no perfect children, and where there are examinations. The first thing is not to mistake *your* work for your pupils'. Don't think that if you shout yourself hoarse, and run round your class, like a sheep-dog round his flock, till the perspiration comes and your temper goes, that you are *teaching*. I know some pupil teachers who go home at night utterly exhausted and unfit for their own studies, and yet their teaching has not been real teaching.

Don't think that this excuses laziness. The teacher who makes his class work may be a very quiet person, he may not ruin his throat or blister his feet, but he is *not* lazy. All his wits are on the stretch the whole time, to prevent any individual in the class from shirking work.

While you avoid noise and all unnecessary exertion, don't run to the opposite extreme, and aim at that silly Red Indian impassiveness that some teachers admire. Vivacity and sympathy don't bark our throats and blister our feet.

Our first and lowest use as teachers, then, is the policeman use. We make sure that our pupils educate themselves regularly. We 'cause them to know' a certain amount every day; many of them, if left to themselves, would learn nothing at all.

Secondly, and, from a pupil-teacher's point of view, chiefly, we aid the pupil in his work by showing him *how to learn*. This is the point in which self-education usually fails. The self-educated man no doubt learns what he wants, and learns it extremely well. But he makes great mistakes. He learns things that are of no use to him with exactly the same care as he gives to really useful things. He does not know where to get information, and frequently loses much valuable time in hunting for what a teacher could lay his hand on at once.

This, too, is where pupil-teachers very often fail. They give out so many words to be learnt for spelling, so many lines of dictation, so many counties for geography, so many pages for history, and think their part of the work is done. Even such teachers have their use—the policeman use. But the true teacher shows *how* to prepare—observe, he does not prepare.

Take the Dictation lesson, for example. The ordinary boy is a creature of rules. He will tell the teacher that he has prepared his dictation by spelling every word in it, say three times. That is, he spells over t-h-e three times every time it occurs, and spells the treacherous 'village' no oftener. Your place is to show him—with a *different* passage

from that he has to prepare—how to pay special attention to dangerous words.

Take the History lesson, again; most pupils read it as all of equal importance—if anything, trifling details being regarded as of the greater importance. The boy who was asked on what charge Monmouth was executed, and answered 'For stealing peas,' showed clearly that he had read the chapter to no purpose. He had been struck by the unimportant detail of the contents of the rebel's pockets, and had put his schoolboy ideas of crime into the incident. To help the pupil here the teacher must (1) go over a few such incidents, selecting the really important facts, so as to give the pupils an idea of their relative importance; and (2) ask sensible questions, questions that do not demand a knowledge of some petty detail. A pupil will never rise above the level of the questions to which he is accustomed.

A third and most important way in which a teacher is of use, is in selecting what his pupils should study, arranging studies to suit different capacities, and presenting certain difficulties just at the stage at which the pupil is prepared to face them. This sort of work is, however, hardly in your way; it belongs to the Headmaster, the Inspector, the Parents, the Department, the General Public. So you can afford to let it alone.

One fundamental consideration, however, you cannot afford to neglect. If you want to prove useful as a teacher you must think of the *processes* of education much more than you are in the habit of doing. The question is not 'How much do my pupils know?' but 'What powers in my pupils have I caused to act and to become strong by practice and training?' Your own training is apt to give you too high a respect for the height of Kinchinjunga and the population of Jamaica, and too little consideration for the power implied in a skilful use of an atlas and a gazeteer. Your pupils will be judged in the world, not by the facts they know, but by the use they can make of them.

NOTES AND NOTIONS.

BY RICHARD WADDINGTON.

'Brief life is here our portion' has been brought home with a realism that is appalling in its suddenness. A few short weeks ago four of us sat in a London restaurant. We had just completed ten hours' hard labour at Russell Square. My *vis-à-vis* was Alfred Richmond, bright, hopeful, and enthusiastic. No thought of a few short weeks of life, but an insensible conviction that 'death's pale flag is not advanced there.' We who monthly congregate at Russell Square mourn a faithful, warm-hearted colleague, the Union a self-sacrificing brother, cut down on the threshold of manhood. Sad as is the Union's loss, the 'thoughts that do often lie too deep for tears' of twenty-five thousand teachers throughout the length and breadth of the land turn in silent sympathy to the loved ones left behind. Around the open grave that is to enclose the corporeal remains of Alfred Richmond twenty-five thousand teachers will in spirit assemble to pay homage to a departed brother, and to pray that He who is the giver of all may grant grace and fortitude to the bereaved wife and child.

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Mr. Pope, in his address to the London Board Head Teachers' Association, spoke in anticipation of the substitution of inspection for examination,—an anticipation that it is to be hoped will become a realisation when the 1895 Code is issued. And as soon as Mr. Pope left 'the dim twilight of antiquity,' and began to summarise the benefits that would accrue from the reform, he became a convert to the 'Age and Attendance' programme of the N.U.T. But to prevent any possibility of misconception, I had better quote Mr. Pope's eighth benefit:—

'School attendance would be improved as a result of the healthier and more popular character of the work in schools. Already, I believe, the night schools in England have doubled their numbers as a result of the abolition of the annual grind, to which, as every night school teacher knows, very few of the pupils—upon whom the ordeal was optional and not compulsory, as in day schools—would submit. *In addition to this, school attendance would be improved, because with the abolition of the annual examination and the standard qualification of labour it would be possible to institute a system of regular attendance as the exemption qualification. By this means parents who now have no interest in the matter would be led to co-operate with the teachers in securing regular attendance.*'

So admirably is the case stated that I have ventured to print the latter part in italics.

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There is but one difficulty in the path that leads to the abolition of the Annual Show Day—the requirement of a standard certificate for employment. With the present low age for exemption—for it must be borne in mind that at present the age is ten, and will only be raised to eleven on the 1st of January next—no Education Minister will entertain 'age only' as possible or desirable. It may be possible early in next century to obtain a hearing for 'age only;' but meanwhile, as practical experts, we are compelled to guide the Vice-President to a reasonable solution of the difficulty that bars the way to the emancipation of the teachers and scholars from the harass and, too often, sycophancy of the 'annual visit.'

* * * * *

The London Assistants have laid down a comprehensive programme. At least one of the items ought to be engrafted on the N.U.T. programme. I refer to 'That in future no department of a school be constructed to accommodate more than 400 children.' The massing of a thousand children under one head teacher—and this is fast becoming the order of the day in the large provincial towns—is a species of educational sweating that demands attention. Time was, and that not long ago, when the head teacher exerted an influence of no mean potency over the individual scholar, and 'the nodding horror of whose shady brows' brought many a youthful wandering in the paths of idleness and indifference to an abrupt termination. I have visited schools where it might be said of the children—

> 'It were a journey like the path to heaven
> To help you find them,'

so extensive were the buildings. The Department regulates the individual teaching capacity, and then allows the controlling capacity of the teacher to reach absurd limits. I have heard of one head master who controls a school of some 2,000 scholars. What other can he be but a mere examiner? What individual influence can he exert over the true education of the taught?

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So long as the London School Board confined its theological discussions to the 'Compromise of 1870,' teachers could afford to stand by and watch the struggle of parties to make an election cry out of the debate. But the latest move is so serious in its influence that indifference is impossible. Practically, the recommendation of the School Management Committee will mean an inquiry into the religious tenets of applicants. That this has been in vogue more or less under some of the provincial School Boards is quite true. But even in such cases the inquiry has been unofficial. It is said that under the majority of Welsh School Boards—'no churchman need apply,' and it is equally true that under many School Boards no Roman Catholic has a chance of appointment. The London School Board wants Bible teachers. Do the teachers at present in the service of the Board fail to give this instruction? Is there a teacher worthy of the name who enters the Board's service who is not prepared to do everything in this that the Board can justly demand? As a Church teacher, I do not hesitate to affirm that the School Management Committee's suggestions would make a stricter inquiry than is made in many Church Schools.

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Mr. E. P. Arnold-Forster has issued a pamphlet on the advantages of a Decimal System, in which he points out that a bushel of corn in 189 different corn markets in England stood, in 1891, for no less than 46 different measures of wheat, varying from 52 lbs. to 90 lbs. No body of persons are so cognisant of the absurdities of our present system as teachers. It is simply appalling to think how much of the school-life of a child is wasted through our senseless craze for minute accuracy in spelling, and the struggle with an absurd and, in many instances, obsolete system of tables. Mr. Arnold-Forster says:—

> 'We describe distances on a road by miles and quarters of miles, and distances at sea by knots. We express the height of a tree or a tower or the Pyramids in feet, and the depth of water in fathoms, and the depth of a mine in yards. A man in a tall hat measuring ground for sale speaks of chains, while the same man in flannels measuring a cricket pitch thinks only in yards. We measure ourselves in feet and inches, our horses by hands, our cloth by yards and fractions of yards, our walls by roods, and the calibre of our guns by inches and decimals of inches.' But the list of our absurdities in these matters is inexhaustible. When we consider their consequences, however, we cease to be amused. 'The infinite variety and confusion of our weights and measures creates immeasurable friction in our every-day dealings, it is the cause of wasted years of woe and heartburnings to teachers and scholars in our schools, and it must seriously impede our free and unfettered intercourse with foreign countries.'

It is time teachers took up this question more seriously. The time of the Oxford Conference might be worse spent than in discussing a practical paper by some well-known man.

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The coal struggle is ended. To-day the merry music of the collier's pick brings happiness to thousands of scholars and teachers. The efforts of many of the teachers have in numberless cases been almost superhuman. In my last month's "Notes and Notions," I gave the amounts received up to date:—

	£	s.	d.
Amount previously acknowledged	31	19	11
Anfield Road Board School (per Mr. J. E. Parrott, B.A., LL.B.)	2	0	0
Compton National School, Plymouth (per Mr. T. Roberts)	0	13	6
Union Teacher	0	2	0
Scholars of Prittlewell School, Essex	0	1	9½
Hague Bar Board School, Hayfield (Mr. J. H. Gregory)	1	1	3
Arlesey, Herts (Mr. G. H. Knight)	0	5	6
Mr. R. Monat, Stisted, Braintree	0	2	6
Mr. T. W. Whale, Ruyton XI. Towns	0	5	9
Aberllechan School, Mixed Department, Pontypridd (Mr. A. Sampson)	0	7	0
'A. D.', Burton-on-Trent	0	1	0
Broadwell School, near Stow-in-the-Wold, (Mr. Hodge)	0	7	0
Ripon Wesleyan School (B. M. Smith)	0	4	0
Bushey, Herts (S. M. Bamford)	0	5	0
'Brockley,' S.E.	0	2	6
Mr. Monat, Stisted, Braintree	0	7	6
Curledge Street Girls' E. C. School	0	0	8½
Weobley Parochial School (Mr. E. Rycroft)	0	11	6
Aspley Guise Board School (Mr. G. H. Taylor)	0	7	0
Fleet School, near Winchfield (Mr. A. J. Ranson)	0	6	0
	£39	11	5

If any subscriber desires to see the way in which the amount has been distributed, I will forward the list. Every penny of the £39 11s. 5d. has gone directly for relief. The many letters I have received show how much the fund has done to keep starvation from the little ones. One teacher writes: "The children are delighted to think that other scholars have been so thoughtful on their behalf. I should like to show my appreciation by an entertainment, before next year is out, for the Benevolent Fund. It would get a few pounds for the orphans, and at the same time be a thank offering from benighted Chowbent."

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The question of imposing a levy for the purpose of raising the miserable salaries now paid to many certificated teachers appears to have raised the old trades union discussion. Here are the facts. Conference decided at Easter that something must be done. This year's Blue Book show that there are:—

		£
275	Principal mistresses receiving under	40
663	Assistant mistresses receiving under	40
47	Principal masters receiving under	50
128	Assistant masters receiving under	50
1113		

Eleven hundred and thirteen *certificated* teachers working for less than £1 per week. Can the Union stand by and allow such figures to appear year by year? Call it by what name you like, something must be done to prevent this sweating. There is no necessity for a general strike. Most of these teachers can get more in the open market if you will make it possible for them to enter. *Then will come the Union's duty in seeing that the vacancies are not filled at the price.*

* * * * *

On the 1st of January next Mr. Acland's Elementary Education (School Attendance) Act becomes

operative. Under this Act, which is not retrospective, the age for partial and total exemption under the Education Act will be raised from 10 to 11, except in a few districts where already the bye-laws provide that 11 is the age. The effect of this will be that in the districts where the fourth is the total exemption standard—and this standard pertains for one third the population of the country—the school life will be extended a year. And in the 68 districts where compulsion ceases at 10 a similar result will follow. The age for half-time employment will be uniform under both the Education and Factory and Workshop Act; but there uniformity will cease. The Education Act half-timer will still be allowed to attend at pleasure. Nay, in the new 'Model Bye-laws' just issued by the Education Department half-time attendance is defined as making 150 attendances a-year. What a farce! The child having scored the 150 attendances in the early months of the year bids adieu to school until the examination, some seven or eight months after. Can a more wasteful system of education be imagined? But it is truly English!

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Turning to the Blue Books to gather the probable effect of the change, I find that there were 98,000 Education Act half-timers last year, and it may be taken that 30,000 of these are between ten and eleven. Twelve months hence we may look for a considerable reduction on the 98,000. The effect on the full-timers cannot so easily be prognosticated.

	Scholars.
In 1891 between 9 and 10 there were - -	563,588
In 1892 between 10 and 11 there were - -	566,049
Increase in 1892 - - - -	2,461

Where did these 2,000 children come from? It must be borne in mind that at least 5,000 who were between nine and ten in 1891 were totally exempt at ten in 1892. Of course the rural teachers and many of the urban teachers can give the reason. *There must have been at least* 10,000 *children brought into school for the first time at ten years of age in* 1892. When will Mr. Acland deal with this phase of the question? If the age had been raised to the Berlin Pledge—12, something like 40,000 children would have been affected. The fact is that public opinion is in advance of the Statute Book on the question.

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Christmas greetings and 'Glad tidings of great joy' in 1894 to all my readers.

SCIENCE NOTES.

The New Savillian Professor of Astronomy.—The distinguished band of Cambridge men who have been elected to professorship at Oxford has recently been added to by the appointment of Mr. H. H. Turner to succeed the late lamented Prof. Pritchard in the Savillian chair of astronomy. Mr. Turner had a distinguished career at Cambridge, being in succession Scholar and Fellow of Trinity College. He graduated with high mathematical honours, being second Wrangler and Smith's prizeman in 1882. After some time spent in the teaching of practical astronomy at Cambridge, Mr. Turner was appointed chief assistant at the Greenwich observatory.

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Light and Micro-Organisms.—One of the most important pieces of research in the new field of bacteriology has just been completed by Prof. H. Marshall Ward, of the Royal Engineering College, Cooper's Hill. He has had under observation for many months the influence of light on the various micro-organisms, which he finds to be far more deleterious to them than has been supposed. Exposure of a number of them suspended in a gelatine medium to the action of the sun's rays for only a short period, in some cases for only half-an-hour, has so far injured them that they have been made incapable of growing or multiplying, or of producing their usual effects in liquifying the gelatine. The electric light proves to be almost equally efficacious, the arc light being the most advantageous form to use. By throwing the electric beam through a prism on to the culture plate, Prof. Ward has found that the various rays into which the beam is split have very different bactericidal powers, a very good image of the prism being the result of the exposure. From his experiments some very valuable lessons may be learnt as to the effect of sunlight in the purification of water. They must have a very important bearing on many problems of sanitation.

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The Deleterious Principle in Influenza.—The great prevalence of the influenza scourge during the past few years has attracted the attention of many workers in the field of pathology, and results of some value are now being obtained. The latest of these is the discovery by MM. Griffiths and Ladell, that during the progress of the disease a special prismous ptomaine is produced which leaves the body by means of the kidneys. The discoverers describe it as a white substance, crystallizing in prismatic needles, which are soluble in distilled water, communicating to it a weak alkaline re-action. It forms double salts with platinum and gold, and is precipitated by several acids, the precipitate being of different colours in the several cases. With phospho-tungstic acid it is brown, with phospho-molybdic acid and with picric acid it gives various shades of green, while with tannic acid it is red. When injected into the blood it is found to be highly toxic, causing a high fever, followed by death in less than eight hours. The authors prepared it from the urine of patients suffering from influenza, by making the liquid alkaline and then extracting with sulphuric ether. They think it probable that this body is the result of the activity of the bacillus discovered by Pfeiffer and by Kitasato, and deemed by them to be the specific microbe of influenza.

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Preparation of Metallic Lithium.—Recent work by M. Guntz has resulted in the discovery of a new method of preparing this somewhat refractory metal. It has hitherto been most satisfactorily procured by the action of the electric current on the fused chloride, but a great difficulty has been the extreme heat to which it is necessary to expose the salt to secure fusion. Lithium chloride only melts at a temperature approaching 600° C., and when electrolyzed at this point, the freed metal immediately forms a subchloride which is very resistant to the passage of the current and so checks the action. Guntz finds that if the lithium salt be mixed with an equal weight of chloride of potassium, the fusion is complete at about 450° C., and the metal then set free by the electrolysis does not form the refractory compound, but can be separated easily from the fused mass. It then is found to be nearly pure, only one part of potassium being mixed with 273 parts of lithium.

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Glucoside Ferments in Plants.—M. Guignard, to whose classical researches on the glucosides in the Cruciferæ and Rosaceæ we attribute so much of our knowledge on this feature of vegetable metabolism, has been extending his researches into the families of the tropœolaceæ or Indian cresses, to which our common nasturtium belongs. He finds the peculiar pungency of this group to have a similar origin to that of the radish and mustard family, there being present in the tissues a peculiar sulphur-containing principle to which it is due. Guignard also finds in this group a ferment, which in its action is similar to the emulsin and myrosin of the first-named plants, which decomposes the glucoside with formation of sugar and the peculiar aromatic body with which we are familiar. He has detected the ferment in the root, stem, leaf and seed, though it is rather difficult to determine in the latter case. The leaves contain it in larger quantity than the stem.

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Antiseptic Action of Fluorides.—Some curious effects produced on the alcoholic ferment by fluorides have been recently investigated by Effront. When pure yeast is cultivated in solution of sugar, it is well-known that its active multiplication and growth goes on *pari passu* with the production of considerable quantities of alcohol, the various yeasts known to brewers having, however, different powers of bringing this change about. A little ammonium fluoride added to such a fermenting mixture in wort causes very marked interference with the multiplication of the yeast cells. The

latter, however, possess a certain capacity for overcoming the deleterious influence of the salt, for if removed to another wort containing about the same proportion, they are found to be much more hardy, growing fairly freely. By treating various yeasts with fluorides for some time, gradually increasing the quantity, the fermenting power of the cells is found to rise until it may attain ten times what it originally showed.

***

PERFUME OF THE VIOLET.—After nearly ten years of persevering labour, MM. Siemann and Krüger have succeeded in ascertaining to what the odour of the violet is due. They have isolated a body to which they give the name of *irone*, and find it present also in the so-called orris root. It proves to be an oily body, soluble in alcohol, ether and chloroform, boiling at 144° C.

***

SENSE OF TASTE IN THE RED AND WHITE RACES.—A somewhat new departure in physiological research has been made by Mr. Bailey in Kansas. Investigations have long been on record as to the localization of taste on the tongue of European subjects. Mr. Bailey has extended these to the Indians of North America. The method of testing was the same as hitherto adopted and consisted of putting upon different regions of the tongue drops of solution of quinine sulphate, sulphuric acid, bicarbonate of soda, cane sugar, and common salt, these causing to the sensations bitter, sour, alkaline, sweet, and salt respectively. A few differences were noted between the red men and white. By the latter, sweet solutions could be detected more easily than alkaline ones, while the reverse was the case with the Indians. The latter had great difficulty in distinguishing between the alkaline and salt sensations. On the whole the red men were less sensitive to the different fluids than the white, the latter detecting in all cases more dilute solutions than the former. The males of both these were able to detect salt more easily than the females, but the reverse was the case with all the other sensations.

CONVERSATIONAL LESSONS IN CHEMISTRY.

BY THOMAS CARTWRIGHT, B.A., B.SC.(LOND.).

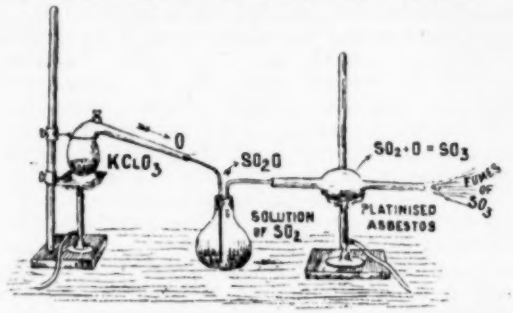
First Class Honoursman in Chemistry, S. and A. Department, Lecturer in Chemistry to the Middlesex County Council, and in Physiography to the Birkbeck Institution, Chancery Lane, E.C.

For particulars of the List of Chemicals and PRACTICAL TEACHER Set of Apparatus for working the experiments referred to in these lessons see numbers for January and February 1893.

LESSON XI.—SO_3 AND H_2SO_4.

In our last lesson we gave attention to sulphur dioxide, and we said that this was not the only substance which is chemically formed out of sulphur and oxygen. You tell me, Arthur, what was the other body which we said was formed by the combination of these two elements? Well, suppose the only difference is the addition of another atom of oxygen, what name might we give this body? At last, I see you understand me. Well, Arthur, what would you call it? Sulphur trioxide, sir, and I should write it thus—SO_3. How can we form this body? Now, think; and I am sure you will be able to help me. Well, Laura, what do you think? Could we not burn sulphur in air or oxygen, and would not SO_3 be formed then? You answer that question, Tom, from what we have already said. The body formed when S burns in air or oxygen is SO_2, but, I think, you told us that SO_3 is probably formed and immediately decomposed. Whether I told you or not the answer is quite correct, so that we must try another method. What can you suggest, Frank? Could you not add another atom of oxygen on to SO_2, and so obtain SO_3? Yes; and that is the way in which we shall proceed to obtain our SO_3; but it is not an easy matter to bring about the desired combination.

The apparatus which you see I have sketched on that blackboard will explain how the body may be formed.



In the retort we have a mixture of $KClO_3$ and MnO_2, which, when heated, evolves a stream of oxygen which bubbles through the solution of SO_2 and causes some of the gas to be carried over mixed with the oxygen, and this mixture of O and SO_2 passes through the bulb-tube and over the platinised asbestus. Now, in contact with platinised asbestus, the O can unite with the SO_2, but without such contact no union will take place. We call this kind of action contact action, and we have to confess that we cannot understand why the mere presence of platinised asbestus should be able to bring about combination between two bodies which otherwise would not combine. Such, however, is the case, and there are many similar ones, one being quite familiar to you. Can you point this out to me, Annie? Yes, sir; here it is before us in the shape of the manganese dioxide, which causes the chlorate of potash to yield up its oxygen more readily and in greater abundance than it would do if heated out of contact with the MnO_2. Well done, Annie, and now to our SO_3. What is its state of aggregation? It is a gas, sir. No, it is a solid, of a silky-white appearance; but the body vaporises at 46° Centigrade (remember water boils at 100° C.), and these vapours combine with the moisture of the air to form the all-important sulphuric acid of which we shall have much to say. Suppose we wanted to convert our SO_3 into the white, silky solid form, how might we proceed, Charlie? You would pass the fumes down a condensing worm which is surrounded by a freezing mixture, such as ice and salt, and the cold would cause condensation of the gas. Yes, and you would find the solid a very interesting body to experiment with, for if dropped into water it seethes and combines with so much energy as to cause an explosion, and in each case the body formed is the well-known sulphuric acid. Hence, what name do we apply to SO_3, Bob? It is an anhydride, sir, as it is an acid when added to water. Just so, and it is the fact that SO_3 is the anhydride of the most important of all acids, which gives it its great interest. The following equation shows what takes place when the bodies in question are brought together:—

$$SO_3 + H_2O = H_2SO_4,$$

and we will at once proceed to discuss this most important of all acids.

Sulphuric Acid.

Here is a specimen of the body which I want you to carefully observe, in order that you may see whether or no the body which we shall prepare later on is really the same as this now before you. First of all look, Trixie, how thick the liquid is, and how much like oil it appears. For this reason it was called oil of vitrol, although, of course, there is nothing in common between the acid and oils except the appearance. Which should you think was the heavier, Frank, the acid or water? The acid, sir. Well, put the matter to the test by weighing an equal volume of each, and then let us know the result. The acid, sir, is nearly twice as heavy as the water. True, my boy; we estimate the weight of all liquids and solids by comparing them with water, and this relation between water and other liquids is called their *specific gravity*, and the specific gravity of sulphuric acid is 1·8, so that your determination, Frank, was a fairly accurate one. Now for you, Annie; take a beaker, pour into it some water,

and then add to it some of the acid. What do you notice? The beaker, sir, is quite hot. But what has made it hot, Annie? I can tell you, sir. Very good, Ernest; proceed with your explanation. The heat is a result of the chemical combination, just as in the case of the heat which turns some of the water into steam when the water was thrown on the quick-lime. Quite true, and please learn from this that H_2SO_4 has great affinity for water, with which it readily combines. For this reason we use the acid as a *drying* agent. If we place some of the acid in a shallow vessel, and put it under a closed space, such as a bell jar, any moisture contained in the air or in any substance placed under the jar will be absorbed by the acid: moreover, if we heat many substances containing H and O, in the proportion to form water, with H_2SO_4, the acid will extract from them the H and the O, an operation which is of immense service to chemistry. Here, Minnie, is some saltpetre (KNO_3) which I want you to heat in a retort with some H_2SO_4, and collect the liquid which distils over in a receiver. It is nitric acid, as we shall prove when we discuss that body, and this is the way in which we obtain that very important compound. Another acid—Hydrochloric acid (HCl)—is only to be obtained by the agency of H_2SO_4, and as chlorine, an element of immense importance in calico bleaching, is prepared from HCl, and as many other substances equally important for the comfort and convenience of men can only be obtained by the agency of this same acid, you can see how supremely useful this oil of vitriol is, both to the chemist and to the manufacturer. You will therefore not be surprised to learn that the manufacture of sulphuric acid has received much attention, and that it is carried on on a large scale both in England and in all manufacturing countries.

Now let us see what are the essential steps in the preparation of this important product.

You, Frank, shall tell us what must be the starting point. We started with sulphur dioxide. Exactly so, and that is the usual starting point both in the laboratory and in the factory, but there are many ways of getting the dioxide. You, Annie, please tell us one. I recollect, sir, that you said the easiest way was to act upon H_2SO_4 with copper. Quite true, and that is the way we shall proceed in our manufacture; but what other way can you mention, Frank. Can we not burn sulphur in air or oxygen? Yes, and that, in very truth, one of the ways adopted in the factory, crude or impure sulphur being imported from Sicily and other places for this purpose. Now I will tell of a third and even more common method of obtaining the SO_2 which is needed as a starting point in the manufacture of H_2SO_4. Compounds of metals and sulphur, called sulphides, are exceedingly common, being found in all parts of the world, and the commonest of them all is the iron compound which is sulphide of iron. When this is burnt in air or in oxygen, iron oxide and SO_2 result. You may therefore take 'roast pyrites for SO_2' as one of the first rules for the making of H_2SO_4. What now is the next step, Trixie? We wish to convert the SO_2 into SO_3, and I suppose you will use platinised asbestus again. By no means. It is far too dear, and everything concerned in the production of H_2SO_4 must be cheap, as the acid is sold at as low a figure as 1d. per lb. When we discuss the oxides of nitrogen you will learn that one of them, to wit, nitric oxide (NO), behaves peculiarly with respect to oxygen. It readily combines with this element, and just as readily yields O to any body which has affinity for it: for this reason it is well qualified to play the part of oxygen carrier between O and some other body which cannot directly combine with O. The equation which you see on the board illustrates this:—

$$(1)\ NO + O = NO_2.$$
$$(2)\ NO_2 + SO_2 = SO_3 + NO.$$

Theoretically this action is continuous, and in actual practice it will go on for a considerable time. Now, John, what do you want? How can we get the nitric oxide? Our way will be to act upon nitric acid with copper; but a much cheaper way is to decompose nitric acid, which is cheaply prepared from Chili saltpetre ($NaNO_3$) and H_2SO_4. These vapours of SO_2 and NO_2 are led into a leaden chamber (lead being able to a considerable extent to resist the action of the acid). Jets of steam are also conducted into the leaden chamber wherein the following reaction takes place:—

$$NO_2 + SO_2 + H_2O = H_2SO_4 + NO,$$

the NO being immediately reconverted into NO_2 by the oxygen of the air in the chamber. The acid is collected in water at the bottom of the chamber, and afterwards is concentrated by being heated in leaden pans, and again in glass or platinum vessels, as the concentrated acid more readily attacks lead.

Now let us prepare some of the acid. You, Charlie, get ready a flask with thistle funnel and leading tube, into which place some Cu and H_2SO_4 (strong). This, when heated, will yield SO_2. You, Laura, prepare a similar flask with Cu and HNO_3. This will give a supply of NO. Charlie shall get a bladder which will be used in supplying air to our substitute for a leaden chamber, whilst Arthur will get a flask with water for boiling to supply us with steam. A large flask with a five hole cork will receive all our leading tubes, and in addition will be provided with a tube to serve as a vent.

$$NO + O = NO_2$$
$$NO_2 + H_2O + SO_2 = H_2SO_4 + NO.$$

You will readily see that H_2SO_4 will be produced. That it is H_2SO_4 can be proved (1) by heating with Cu, when SO_2 will be given off, and (2) by adding some barium chloride solution ($BaCl_2$), which will give a white precipitate insoluble in all acids. Now study carefully all the reactions by which H_2SO_4 is produced, and you will have mastered a very important part of your chemical work.

JANUARY, 1894.

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Section I.

[*Only one Question may be answered in this Section.*]

1. From Ephesians, chap. vi. verses 1–18, show what is the duty of—

(*a*) Children to their parents.
(*b*) Servants to their masters.
(*c*) Masters to their servants.

And explain what is meant by 'Put on the whole armour of God.' Against what enemies is this armour to be used?

2. Show from 1 Corinthians, chap. xiii., what is meant by 'Charity.'

3. Give some lessons to be drawn from any one of the Psalms that you have committed to memory.

Section II.

[*Only three Questions may be answered in this Section.*]

1. What is stated about John the Baptist in the First Chapter of St. Mark's Gospel? What lessons would you learn from the life of John the Baptist?

2. Explain:—

(*a*) 'The Sabbath was made for man, and not man for the Sabbath.'
(*b*) 'This people honoureth Me with their lips, but their heart is far from Me.'
(*c*) 'The Son of Man must suffer many things.'
(*d*) 'For what shall it profit a man if he shall gain the whole world, and lose his own soul?'
(*e*) 'Children, how hard it is for them that trust in riches to enter the kingdom of God.'
(*f*) 'And as touching the dead, that they rise: have ye not read in the book of Moses, how, in the bush, God spake unto him, saying: "I am the God of Abraham, and the God of Isaac, and the God of Jacob?"'
'He is not the God of the dead, but the God of the living: ye therefore do greatly err.'

3. Write out and explain the parable of the Vineyard let out to unthankful husbandmen.

4. Describe the Crucifixion of our Lord, as related by St. Mark.

5. Give an account of the triumphal entry of our Lord into Jerusalem.

6. What request did James and John the sons of Zebedee make to our Lord? How did he answer them? What lesson would you learn from this incident?

Section III.

[*Only two Questions may be answered in this Section.*]

1. Give the substance of Solomon's prayer at the dedication of the Temple. What answer did God make to this prayer?

2. Give an account of Elijah and the prophets of Baal on Mount Carmel.

3. Give an account of the visit of Isaiah to Hezekiah, king of Judah. What lessons would you learn from this incident?

4. Write what you know of Eli, and state what lessons you would learn from his life.

Standard VI.

Section I.

[*Only one Question may be answered in this Section.*]

Write out Proverbs, chap. xii., verses 17, 18, 19, and 22, and any two other verses from Proverbs that you know, bearing on truthfulness.

Explain the passage: 'There is that speaketh like the piercing of a sword.'

2. Write out the passage from Isaiah beginning, 'Ho, every one that thirsteth,' and ending 'He hath glorified Thee.' On what occasion did our Lord refer to living water?

Section II.

[*Only two Questions may be answered in this Section.*]

1. What do you know about Isaiah, the writer of the passages you have studied?

2. How did Isaiah teach the Jews to observe the Sabbath?

3. Explain the following passages:—

(*a*) 'The God of Israel will be your rereward.'
(*b*) 'Behold ye fast for strife and debate.'
(*c*) 'I will bring forth a seed out of Jacob.'

4. How does Isaiah describe the arms of defence for the protection of righteousness? Compare his description with that given by St. Paul of a Christian's armour.

Section III.

[*You may answer any three of these Questions, but not more than three.*]

1. Explain the passage 'Think not that I am come to destroy the Law and the Prophets.'

2. What were our Lord's instructions to His twelve Apostles when He sent them forth to preach? (St. Matthew x.)

3. What cities did our Lord compare with Tyre and Sidon, and which with Sodom, and why?

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And explain what is meant by 'Put on the whole armour of God.' Against what enemies is this armour to be used?

2. Show from 1 Corinthians, chap. xiii., what is meant by 'Charity.'

3. Give some lessons to be drawn from any one of the Psalms that you have committed to memory.

Section II.

[*Only three Questions may be answered in this Section.*]

1. What is stated about John the Baptist in the First Chapter of St. Mark's Gospel? What lessons would you learn from the life of John the Baptist?

2. Explain:—

(*a*) 'The Sabbath was made for man, and not man for the Sabbath.'
(*b*) 'This people honoureth Me with their lips, but their heart is far from Me.'
(*c*) 'The Son of Man must suffer many things.'
(*d*) 'For what shall it profit a man if he shall gain the whole world, and lose his own soul?'
(*e*) 'Children, how hard it is for them that trust in riches to enter the kingdom of God.'
(*f*) 'And as touching the dead, that they rise: have ye not read in the book of Moses, how, in the bush, God spake unto him, saying: "I am the God of Abraham, and the God of Isaac, and the God of Jacob?"'
'He is not the God of the dead, but the God of the living: ye therefore do greatly err.'

3. Write out and explain the parable of the Vineyard let out to unthankful husbandmen.

4. Describe the Crucifixion of our Lord, as related by St. Mark.

5. Give an account of the triumphal entry of our Lord into Jerusalem.

6. What request did James and John the sons of Zebedee make to our Lord? How did he answer them? What lesson would you learn from this incident?

Section III.

[*Only two Questions may be answered in this Section.*]

1. Give the substance of Solomon's prayer at the dedication of the Temple. What answer did God make to this prayer?

2. Give an account of Elijah and the prophets of Baal on Mount Carmel.

3. Give an account of the visit of Isaiah to Hezekiah, king of Judah. What lessons would you learn from this incident?

4. Write what you know of Eli, and state what lessons you would learn from his life.

Standard VI.

Section I.

[*Only one Question may be answered in this Section.*]

Write out Proverbs, chap. xii., verses 17, 18, 19, and 22, and any two other verses from Proverbs that you know, bearing on truthfulness.

Explain the passage: 'There is that speaketh like the piercing of a sword.'

2. Write out the passage from Isaiah beginning, 'Ho, every one that thirsteth,' and ending 'He hath glorified Thee.' On what occasion did our Lord refer to living water?

Section II.

[*Only two Questions may be answered in this Section.*]

1. What do you know about Isaiah, the writer of the passages you have studied?

2. How did Isaiah teach the Jews to observe the Sabbath?

3. Explain the following passages:—

(*a*) 'The God of Israel will be your rereward.'
(*b*) 'Behold ye fast for strife and debate.'
(*c*) 'I will bring forth a seed out of Jacob.'

4. How does Isaiah describe the arms of defence for the protection of righteousness? Compare his description with that given by St. Paul of a Christian's armour.

Section III.

[*You may answer any three of these Questions, but not more than three.*]

1. Explain the passage 'Think not that I am come to destroy the Law and the Prophets.'

2. What were our Lord's instructions to His twelve Apostles when He sent them forth to preach? (St. Matthew x.)

3. What cities did our Lord compare with Tyre and Sidon, and which with Sodom, and why?

4. Describe shortly our Saviour's public entry into Jerusalem, and the events in the Temple which immediately followed it.

5. Mention the parables given by St. Matthew inculcating (*a*) Watchfulness; (*b*) Faithful service; (*c*) the various receptions given to God's invitations; and write shortly the substance of one of them.

6. Give the occasions on which our Lord manifested Himself to his disciples after His resurrection, as recorded by St. Matthew, and give His farewell address to them.

Standard VII.

Section I.

[*You may answer the first Question, and either the second or third, but not both.*]

1. Write out all the verses you know from the Book of Proverbs which illustrate the duty of truthfulness.

2. (*a*) Write out St. John, chap. xiv., verses 15–21: 'If ye love me . . . . and will manifest myself to him.'

Or (*b*) First Epistle of St. John, chap. iii. verses 13–20: 'Marvel not, my brethren . . . . and knoweth all things.'

3. (*a*) Write out St. Paul's description of Charity.

Or, (*b*) Write out St. Paul's description of the complete armour of a Christian.

Section II.

[*Only one Question may be answered in this Section.*]

1. For what sins was judgment pronounced against Moab, and what punishments were threatened by God?

2. Explain:—

(*a*) 'I will put my fear in their hearts.'

(*b*) 'They set their abomination in the house.'

(*c*) 'For thine eyes are open unto all the ways of the sons of men.'

3. Show how God, through Jeremiah, condemned the disobedience of the Jews through the obedience of the Rechabites.

Section III.

[*You may answer any three of these Questions, but not more than three.*]

1. What was the testimony of John the Baptist concerning Christ? Jesus said, 'I have greater witness than that of John.' What was the greater witness?

2. Give an account of our Lord's conversation with the woman of Samaria.

3. Explain:—

(*a*) 'Judge righteous judgment.'

(*b*) 'I am the light of the world.'

(*c*) 'The truth shall make you free.'

4. What do we learn from St. John's writings about the love of God to man?

5. Why did the Jews persecute our Lord, and seek to slay Him?

6. (*a*) After imprisonment, examination and caution, Peter and John reported to their company what the chief priests and elders had said. Then, as we read in Acts iv., when they heard that, they lifted up their voice to God with one accord and said: 'Lord, thou art God,' &c. Give the substance of this prayer.

Or (*b*) What advice did Gamaliel give to the council with regard to their treatment of Peter and John?

Ex-Standard VII.

Section I.

[*You may answer any three of these Questions, but not more than three.*]

1. Give briefly the story of the flood, as found in the book of Genesis. Mention any allusions to it in other books of the Bible.

2. Illustrate the virtues of kindness, sympathy, magnanimity, and hospitality from the life of Abraham.

3. Narrate the incident in which Melchizedek appears. Give if you can any allusions to him in later books of the Bible.

4. What was the position of the following places? With what events are they connected in the book of Genesis?—Moriah, Bethel, Beersheba, Hebron, Padan-aram.

5. 'Thus Esau despised his birthright.' State exactly what you consider to have been the fault of Esau in the incident alluded to here. How has he been held up as a warning against profanity?

6. By whom were the following expressions used? Show very briefly how each was appropriate to the occasion:

(*a*) 'How dreadful is this place.'

(*b*) 'Thou God seest me.'

(*c*) 'This heap is a witness.'

(*d*) 'I do remember my faults this day.'

(*e*) 'Then shall ye bring down my grey hairs in sorrow to the grave.'

(*f*) 'Bury me with my fathers in the cave that is in the field.'

Section II.

[*You may answer any three of these Questions, but not more than three.*]

1. Say shortly in what ways the gospel of St. Mark resembles, and in what it differs from, those of the other Evangelists?

2. Which of the apostles were fishermen? Give from St. Mark three incidents connected with fishing or with fish, and briefly narrate one of them.

3. 'Whosoever shall do the will of God, the same is My brother, and sister, and mother.' Explain this saying, and relate the incident which caused it.

4. What do the following expressions mean—'Talitha cumi; Ephphatha; Eloi, Eloi, lama sabachthani; Corban'? What erroneous teaching was connected with the last word?

5. Relate the story of the Syro-Phœnician woman.

6. Give the sayings of Jesus (or the substance of them), about—

(*a*) Taking up the cross.

(*b*) Saving one's life.

(*c*) Gaining the world.

(*d*) Being ashamed of Christ.

The paper set for candidates for Pupil Teachership was the same as that for Standard VI., and that for First Year Pupil Teachers the same as that for ex-Standard VII.

Second Year Pupil Teacher Probationers.

Section I.

[*Two Questions only may be answered in this Section.*]

1. 'I pray thee, let me go over, and see the good land that is beyond Jordan, that goodly mountain and Lebanon.'

By whom and on what occasion were these words spoken? Give briefly the answer to the request.

2. Why were the cities of Refuge established? Draw a sketch map showing their positions.

3. Name the five great annual festivals instituted by Moses, and give a short account of one of them? Which of these were feasts of obligation?

4. Name the seven nations 'greater and mightier' than the Israelites. Why were the latter forbidden all intercourse with them?

Section II.

Write notes of a lesson suitable for third standard children, on *one* of the following:—

(*a*) The parable of the Good Samaritan.
(*b*) The death of Moses.

Section III.

[*Three Questions only may be answered in this Section.*]

1. Write a short account of the birth and childhood of our Lord as recorded by St. Luke.

2. State briefly how the Holy Land was divided and governed at our Lord's birth.

3. What do you know of Simeon, Zacchaeus, Simon the Cyrenian, and Cleopas?

4. Write out the substance of the parable of the Unjust Steward. To whom was it addressed, and what did our Lord design to teach by it?

5. Explain the meaning of the following:—(*a*) Tetrarch; (*b*) publican; (*c*) of the course of Abia; (*d*) the sixth hour; (*e*) legion; (*f*) scribe.

6. 'Whom say the people that I am?' To whom was this question addressed, and what answer was given?

Third Year Pupil Teachers.

Section I.

[*Two Questions only may be answered in this Section.*]

1. What places in Canaan are specially mentioned in the First Book of Samuel? Where were they situated and what incidents are connected with them?

2. Trace the gradual declension in character of King Saul, and state what lessons may be drawn from his history.

3. Why does Jonathan appear to us so interesting and noble a person? Mention the incidents in his life on which you base your answer.

4. In what ways was the will of God made known to men in the days of Samuel and Saul? Mention incidents which illustrate your answer.

Section II.

[*Two Questions only may be answered in this Section.*]

1. Mention any ancient prophecies which Matthew says were fulfilled by incidents connected with the birth and childhood of our Lord?

2. How does our Lord in the Sermon on the Mount teach that the precepts of the Old Law are to be extended and kept more perfectly by His followers?

3. How did our Lord answer His two disciples who were seeking distinction above their fellows, and what lessons are we to learn from His teaching on this subject?

4. Compare and contrast the sin of Peter and of Judas?

Section III.

[*Two Questions only may be answered in this Section.*]

1. How did St. Peter in his address on the Day of Pentecost appeal to the Old Testament to prove that Christ had risen?

2. What are we told of the manner of life of the early Christians at Jerusalem? What new order of Christian ministers was appointed at this time?

3. What are we told of the character and life of St. Barnabas, and what lessons may we learn from his history?

4. What places did St. Paul visit on his first missionary journey, and what success did he meet with?

Fourth Year Pupil Teachers.

Section I.

[*Two Questions only may be answered in this Section.*]

1. How does Isaiah describe in chapters xlii. and lxi. the character and mission of the Messiah? What references are made in the Gospels to these prophecies?

2. What sins does the prophet specially mention in chapters lviii. and lix., as having called down the judgment of God? How was God's favour to be regained?

3. How does the prophet describe in chapter lx. the future glory of Israel, and the share which the Gentiles were to have in their blessings?

4. Quote any verses from chapter lv. which show how ready God is to pardon and bless.

Section II.

[*Two Questions only may be answered in this Section.*]

1. Mention any particulars in which the gospel of St. John differs from the other Gospels?

2. What was our Lord's teaching to the woman of Samaria with reference to spiritual worship, and what wrong ideas of hers on this subject did He correct?

3. Relate the story of the healing of the man who was blind from his birth. What lessons may we learn from it?

4. Give the substance of our Lord's last prayer with His disciples.

Section III.

[*Two Questions only may be answered in this Section.*]

1. Give an account of St. Paul's teaching at Athens, and show that his arguments were specially suited for his hearers.

2. What are we told of the impression which St. Paul made on the various rulers before whom he appeared?

3. Where was St. Paul and under what circumstances was he living when he wrote the Epistle to the Philippians? What allusions to these circumstances are made in the Epistle?

4. Quote any verses from the epistle to the Philippians, in which Christ Jesus is held up as an example for His followers.

OUR 1894 CERTIFICATE CLASS.

In our February issue we shall, as usual, commence, and during the year we shall continuously carry on, our Certificate Class.

During the intervening month it is earnestly urged that our intending readers will procure the official syllabus, and start to work at the text of the English authors, and the required History, Geography, Domestic Economy, etc., so that when the articles commence, a rough but firm foundation of main facts may have been laid, whereon we may assist to superimpose the more polished and technical structure.

The test questions will be marked and fully annotated, etc., for 1s. 6d. per week, 2s. 9d. per month, 8s. per quarter, or £1 5s. 0d. the course. Apply early to Dr. George Beach, M.A., Stanley Mount, Macclesfield.

CORRESPONDENCE.

We shall be pleased to reply briefly through these columns to any Subscriber *seeking examinational information or advice, and* Enclosing the Necessary Coupon.

This privilege does not, of course, extend to furnishing the solutions and answers of problems. All such communications should be addressed to 'The Query Editor.'

Replies demanding urgency will be promptly forwarded per post on the receipt of a stamped and addressed envelope, Accompanied by the requisite Coupon.

A post will be saved by writing direct to Dr. George Beach, M.A., (*Examination Editor of* '*Practical Teacher*'), Stanley Mount, Macclesfield.

Dr. Beach desires most heartily to express his sincere gratitude for the numerous enquiries and messages of sympathy, and to the indulgence extended to unavoidable delay during his recent illness.

H.N. (Hull).—You will find the question of musical intervals dealt with this month.

G.W. (Coventry).—The Department has not decided the point. Why not go in for the three years' course, which will probably be in this instance contracted to 2½ years?

F.A.C. (Harborne).—See VII. ii. of present scholarship article.

L.E. (Swansea).—It is not advisable for a P.T. to take the special Welsh History and Geography. He may be thereby grievously handicapped if he wish to enter an English Training College.

P.B. (Belfast).—Apply to Messrs. McGee & Co, Nassau Street, Dublin.

E.E.S. (Ladywood).—If only one unqualified person were present, we believe the proceedings would be invalid. If you are a member of N.U.T. apply to the Law Secretary.

W.N. (Sedgley).—Payment for ordinary books and stationery cannot now be enforced.

T.H.L. (Dundee).—Edward I.'s chief aims were three in number: (*a*) The perfecting of legal *administration*. (*b*) The reform and completion of *legislation*. (See statutes of Westminster, Merchants, Wales, Mortmain, 2nd Westminster, 'Quia Emptores,' etc.) (*c*) The unification of Great Britain.

Science (Reading).—Gregory's 'Physiography,' Merrifield's 'Navigation,' Clarke's 'Principles of Graphic Statics,' Tait's 'Light.'

C.D. (Middleton).—H.M.I. are not giving marks for Fourth Year Samplers.

J.B. (Oldham).—The official remarks respecting Time Tables are not consistent. A conflict is inadvisable; you might lose.

'L.L.A.' (Swansea).—*Επειδε τυγχανομεν προτιρην ειοηκοτες, οτι δει το αἱρεισθαι, μη την υπερβολην*, etc. = Quoniam autem supra discimus medium esse deligendum non minium neque parum, medium autem ita esse, ut recta ratio præscribit, de hoc distinctius disseramus.

R.A. (Weston), S.S.V. (Dover).—Try the Cambridge Senior Local. Attempt the Preliminary and Sections A, B, and G. Address the General Secretary, Cambridge Local Examination, Syndicate Buildings, Cambridge. Will all our correspondents, inquiring respecting Art. 51 (Code), preserve this answer?

Answered per Ordinary Letter.—D.S. (Latheran, Caithness), F.E. (Great Yarmouth); S.E.N. (West Bromwich); J.F.B. (Reading) two letters; 'E.X.' (Bolton); B.H. (Dukinfield); A.L.S. (Ryde); M.T.W. (Gosport); H.P. (S. Heliers); M.T.H. (Crewe); C.B.L. (Wavertree); I.W. (Wantage); H.W.B. (Alnwick); W.A. (Portland); B.U. (Upton Magna); W.B.M. (Coventry); R.N.S. (Warrington); 'Mary' (Burslem); R.T. (Hastings); G.R. (Westminster); H.N. (Hull); W.A.O. (Tredegar) two letters; J.B. (Aston); M.W. (Bedford Leigh); M.J.S. (Hightown); J.P. (Atherstone); W.A.C. (Harwich); A.S.B. (Burbage); W.A. (Nuneaton); E.M.S. (Rockbank); J.W.L. (Selby); J.F. (Burnt Tree); W.P. (Nether Denton); W.W.M. (Barry Dock); E.B. (Tunstall); Sam (Haddlesey); P.G. (Carlisle); W.P. (Hull); T.P. (Ashford); T.W.B. (Fence Houses); T.C. (Great Preston); E.B. (Caulden Lowe); J.H.M. (Edgeley); B.C. (Birkdale); T.W.S. (Marston); A.A.P. (Aldbourne); E.D. (Spring Bank); H.J.B. (Wimbledon); G.H. (Eastover); T.W.B. (Stone); M.A.R. (Bradford); E.H.C. (Scarning); D.M.D. (Blarmaefoldach) two letters; H.D.L.S. (Gloucester); F.W.W. (Felixstowe); R.F. (Hastings); T.W.S. (Marston); A.S. (Tranmere); E.A. (Old Goole); W.H.C. (West Cowes); K.S. (Loughborough); R.B.S. (Chester); R.R. (West Bromwich); J.P. (Atherstone); W. (Uttoxeter); W.R. (Edgbaston); T.J.L. (Macclesfield); 'P.T.' (Solihull); B.G.H. (Whatton-le-Vale); E.H.C. (Scarning); W.R. (Greenley Lane); O.G. (Canterbury); E.W. (Sharow); 'N.T.' (Etruria); L.W.J. (Brook Bank); T.E. (——); T.D. (Ruabon).

LEGAL AND CODE QUERIES COLUMN.

RULES.

1. All communications must be addressed 'Legal Editor, Practical Teacher, Froebel House, St. Andrew's Hill, Doctors' Commons, E.C.,' and must be accompanied by our 'coupon,' duly filled up.
2. Replies will be given *only* in this column, except under the conditions named in Rule 3.
3. If any reader desires a reply by post, such can be forwarded by enclosing, in addition to the coupon, a stamped addressed envelope and either stamps or a Postal Order to the value of one shilling.
4. No original documents should be forwarded, but copies only. We cannot hold ourselves responsible for any losses which occur through non-observance of this rule.

'Legal Tender.'—By the Coinage Act (33 Vict. c. 10.) it is enacted that: 'A tender if made in coins under this Act shall be a legal tender in the case of gold coins for any amount; in the case of silver coins to the amount of 40s.; in the case of bronze coins to the amount of 1s.' By 3 and 4 Wm. IV. c. 98. it is enacted that Bank of England Notes are a legal tender for sums over £5, so long as the Bank of England shall continue to pay their Notes in legal coin. The notes of other banks are a legal tender unless objected to at the time of presentation to the Creditor. A cheque is not legal tender, and can be refused. If accepted, the debt is not extinguished until it has been 'honoured.'

'Drawing.'—The requirements for an Elementary Drawing Certificate (First Class) are:—

(1) Any second grade certificate for Free-hand obtained before July, 1888, *or* A first-class obtained since July, 1888.

(2) Any second grade certificate for Model obtained before July, 1888, *or* A first-class obtained since July, 1888, *or* A pass in Model on the Blackboard obtained before 1893.

(3) A pass in the elementary stage of Science, Subject I., *or* A pass in Section I. and a certificate for Second Grade Perspective.

(4) A second grade certificate for Drawing in Light and Shade obtained before 1893, *or* a first class taken since 1892.

'S.T.'—There should be a Local Secretary in your district. If you write to the Secretary, Science and

Art Department, South Kensington, S.W., stating your difficulty, you will, I have no doubt, receive advice.

'NON-MUSICAL P.T.'—(1) Yes, certainly. (2) Yes, you will be allowed extra marks for the subject named.

'ACTING TEACHER.'—Extra marks are given to Acting Teachers for the same Science in both First and Second Years.

'ONE YEAR'S TRAINING.'—The Education Department stated a few months since: 'No Candidate is admissible under Art. 115(*b*) of the Code who is not "a certificated Teacher,"—that is, who has not been (Art. 55) twice examined. The Article is intended for the benefit of Certificated teachers of some standing; not for those who have just passed their Examination for a Certificate.'

'DAY TRAINING COLLEGE.'—There is a Day Training College at Cambridge, also at Oxford. Oscar Browning, Esq., King's College, Cambridge, is the correspondent to the former.

'W.R.'—There are two Irish Universities located in Dublin, the Royal, and Trinity College. The Royal is an Examining body only, and corresponds, in this respect, to the University of London. It is possible for students while resident in England to enter for the Trinity College Examinations, although it is nominally a resident University. There are, I believe, *three* examinations to be passed before graduation at the Royal, and *nine* at Trinity College. Ladies are not admitted to the Examinations at Trinity, but they are to those at the Royal.

'F.R.G.S.'—If you wish to be authorised to append these letters to your name, write to Mr. D. W. Freshfield, 1, Saville Row, W., who will supply you with the conditions under which such authorization is granted.

'WINDOW TAX.'—I do not wonder at your incredulity, but it is nevertheless true. By 7 Wm. III. c. 18. a tax on windows was levied, and the imposition of this tax does account for the fact that in some old houses windows are 'bricked up.' Houses which contained more than six windows, and which were worth more than £5 per annum, were subject to this levy. By 14 & 15 Vict. c. 36. the 'Inhabited House Duty' was substituted for 'Window Tax.'

G.R.'—The Scotch Education Acts do not prohibit the teaching of sectarian doctrine in the schools provided by a School Board. Parents can, however, avail themselves of the provisions of a Conscience Clause, as in England.

'D.'—The style of writing (large and small) you name will suit admirably.

'RED ROSE.'—If the Managers agree to the course proposed, the Department would probably sanction it. I advise you to obtain the Managers' consent, and request the correspondent to communicate with the Department.

QUERY COLUMN.

Subscriber since May 1885 :—

(*a*) Best book to study 17th century is Davies', published by Philip & Son ; 2s. 6d.

(*b*) You can sit in May 1894 without having passed the elementary stage.

(*c*) No translation of 'Mdlle. de la Seiglière' is published. Any difficulties we will willingly solve.

Excise.—I subtract from 500 a certain number. The remainder I multiply by $\frac{2}{5}$, and from the product I subtract 20 more than its quarter and have 100 left. What is the number I subtracted from 500?

Working backwards :—

$\frac{3}{4}$ Product $- 20 = 100$.
$\frac{3}{4}$ Product $= 100 + 20$.
$= 120$.
$\therefore$ Product $= 120 \div \frac{3}{4}$.
$= 120 \times \frac{4}{3}$.
$= 160$;
Remainder $\times \frac{2}{5} = 160$.
Remainder $= 160 \div \frac{2}{5}$.
$= 160 \times \frac{5}{2}$.
$= 400$;
$\therefore$ Number subtracted $= 500 - 400$.
$= \underline{100}$. Ans.

Excise.—A sum of money will amount at a certain rate of interest to £46 in $2\frac{1}{2}$ years, and to £48 in $3\frac{1}{3}$ years. Find principal and rate of interest.

Interest in $(3\frac{1}{3} - 2\frac{1}{2})$ years $=$ £48 $-$ £46.
" $\frac{5}{6}$ year $=$ £2.
" 1 year $=$ £2 $\times \frac{6}{5}$.
$=$ £$\frac{12}{5}$.
" $2\frac{1}{2}$ years $=$ £$\frac{12}{5} \times 2\frac{1}{2}$.
$= \left(\frac{12}{5} \times \frac{5}{2}\right)$£.
$=$ £6.
$\therefore$ Principal $=$ £46 $-$ £6.
$=$ £$\underline{40}$. Ans.

Interest on £40 for 1 year $=$ £$\frac{12}{5}$.
" £100 " $= \left(\frac{12}{5} \times \frac{100}{40}\right)$£.
$=$ £6.
$\therefore$ Rate $= \underline{6\%}$. Ans.

Can't.—The diagonals of four squares are in an increasing geometrical progression, and the product of the squares of the diagonals of the extremes is to the product of the diagonals of the means as a side of the third is to the square root of the common ratio divided by $4\sqrt{2}$. Required the diagonal of the third square, and the common ratio, supposing their difference equals 45.

Let $\frac{x}{y}$, x, xy, xy^2 = the diagonals.
Since the diagonal : a side :: $\sqrt{2} : 1$,
then the side of third square $= \frac{xy}{\sqrt{2}}$,
and $\frac{x^2}{y^2} \times x^2y^4 : x \times xy :: \frac{xy}{\sqrt{2}} : \frac{\sqrt{y}}{4\sqrt{2}}$,
$\therefore x^2y : 1 :: 4x\sqrt{y} : 1$,
$\therefore x^2y = 4x\sqrt{y}$,
$\therefore xy^{\frac{1}{2}} = 4x$.
Now $y - xy = 45$,
$y - 4y^{\frac{1}{2}} = 45$,
$\therefore y - 4y^{\frac{1}{2}} + 4 = 49$,
$y^{\frac{1}{2}} - 2 = \pm 7$,
$\therefore y^{\frac{1}{2}} = 9$ or -5,
$\therefore y = 8$ (or 25, but this latter value is inadmissible.)
Hence $x = \frac{4}{y^{\frac{1}{2}}} = \frac{4}{9}$,
$\therefore$ diagonal of third square $= \underline{36}$ Ans.

Anon.—A woman sold out of a basket of eggs—

$\frac{1}{3}$ less by 25 of what she had to A,
$\frac{1}{4}$,, 44 ,, ,, B,
$\frac{2}{5}$,, 50 ,, ,, C.

How many had she?

$$\frac{1}{3}+\frac{1}{4}+\frac{2}{5} = \frac{20+12+45}{60} = \frac{77}{60} = 1\frac{17}{60};$$

$\therefore \frac{17}{60}$ of the No. $= 25+44+50 = 119.$

$\frac{1}{60}$ of the No. $= 119 \div 17 = 7;$

$\therefore$ No. $= 7 \times 60 = \underline{420 \text{ eggs.}}$ Ans.

Note.—The numbers in the question have been altered, as those given did not prove. You will see the method of solution of similar questions.

HONOURS PHYSIOGRAPHY NOTES.

BY R. A. GREGORY, F.R.A.S.,

Oxford University Extension Lecturer, Honours Medallist in Physiography, Author of 'Elementary Physiography,' &c.;

AND

H. G. WELLS, B.SC. (LOND.), F.Z.S.

Lecturer in Geology at the University Tutorial College, Fellow (in Honours) and Doreck Scholar of the College of Preceptors.

THE authors of these notes would be glad if teachers or students of Honours Physiography would let them know of any point upon which information cannot be obtained from text-books devoted to that subject. If the matter is of general interest, and likely to form the subject of an examination question, a note upon it will appear in the following number of the 'PRACTICAL TEACHER.'

There is no recent work to record this month in the astronomical side of Physiography, so we take the opportunity of giving a summary of facts relating to some of the celestial bodies, believing that students will be benefited by having the information brought before them in a condensed form. Before proceeding further, however, it may be well to reply to a question received from a correspondent as to 'the changes brought about in the right ascension, declination, and longitude of stars by luni-solar precession.' The effects referred to are stated on p. 136 of *Advanced Physiography*, but we present them here in a form which will, perhaps, enable students to answer any question upon the same subject which may be asked in future examinations. Another reason why the question is answered here is that students who have a difficulty in understanding one explanation can clearly grasp the facts when they are presented in another light.

The stars can be considered to occupy fixed positions in the sky. For convenience we refer the positions of stars to certain imaginary points in the sky. It therefore follows that if the points of reference change, the distance of any body measured from them must appear to alter. The changes referred to in the question are brought about in a similar manner.

Where the plane of the earth's equator cuts the sky, a great circle known as the celestial equator is produced. In like manner, the points where the earth's axis intersects the celestial sphere are the celestial poles. Right ascension is measured along the celestial equator from the 'first point of Aries,' one of the points where the celestial equator cuts the ecliptic. The same starting point is used for celestial longitude, but measurement is made along the ecliptic instead of the equator. Declination is angular distance from the celestial equator, and is therefore analogous to terrestrial latitude. The complement of declination is polar distance. Changes in the position of the 'first point of Aries' cause changes of right ascensions and celestial longitudes; and changes in the position of the equator cause alterations in the declinations of stars; and therefore in polar distances.

The plane of the equator is inclined at the practically constant angle of $23\frac{1}{2}°$ to the plane of the ecliptic. But, on account of luni-solar precession, the former plane slowly shifts its position, moving completely round, at a nearly constant angle, in a period of about 26,000 years. The poles of the equator must therefore move round the poles of the ecliptic in the same period, keeping at a nearly constant distance of $23\frac{1}{2}°$ from it. On this account, in 13,000 years the celestial poles will have described a semi-circle round the ecliptic poles, and so will be at a distance of $2 \times 23\frac{1}{2}° = 47°$ from their present point. The direction of tilt of the equatorial plane will also have suffered a change of 47°, and this angle will represent the greatest change in the declinations and the polar distances of stars (Fig. 1). After this maximum alteration has been attained, the declinations gradually change towards their former values, which they reach 26,000 years after the commencement of the cycle.

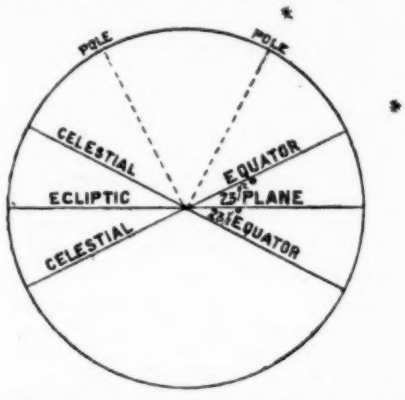

Fig. 1. Showing the difference of position of the plane of the celestial equator with reference to the ecliptic plane after 13,000 years.

The 'first point of Aries' is located by the direction of the common intersection of the equatorial and ecliptic planes—the equinoctial line. And since luni-solar precession causes the former plane to shift its position, the equinoctial line has its direction altered, and tends to perform a *retrograde* revolution at the rate of about 50″.38 a year. But on account of the fact that the obliquity of the ecliptic does not remain absolutely constant, the equinoctial line tends to have a *direct* motion of about 0″.18 per annum. The result is a retrograde motion of 50″.38 − 0″.18 = 50″.2 per annum, and this is the mean rate at which the longitudes of stars increase. The right ascensions of stars are similarly affected by the change in the position of the starting point. This alteration shows itself to the fullest extent in the case of stars near the celestial poles, but is barely noticeable in other parts of the heavens.

SPECTRUM ANALYSIS.

An Element is a substance which cannot be decomposed by any means at present known to science.

The composite nature of white light is shown by passing the light through a prism. Different rays have different refrangibilities; red rays are least bent, violet rays are most bent by a prism.

The Evolution of the Spectroscope.—First, the effect of a prism upon a beam of light was investigated by Newton; secondly, a slit or crevice was substituted for a round hole by Wollaston (1802), then Fraunhofer (1814) used a small telescope to view the spectrum.

The principles of spectrum analysis.—(1) The light from an incandescent solid or liquid, or a compressed gas, forms a continuous spectrum. (2) The light of each glowing gas or vapour is characterised by a set of bright lines belonging to it alone. (3) Each glowing gas or vapour absorbs from a continuous spectrum those rays of which its own spectrum consists.

Fraunhofer lines are dark lines which cross the solar spectrum. By the discovery of the third principle of spectrum analysis by Kirchoff in 1859, the meaning of the lines was revealed. By matching Fraunhofer lines with lines of terrestrial substances, the constitution of the sun is determined.

Sun-spots have spectra of their own. A general widening of Fraunhofer lines occurs where the spot crosses them, indicating a general increase of absorption, and a *selective* absorption is proved by the fact that some lines are more widened than others.

Prominences can be viewed in daylight by means of the spectroscope. The principle of the methods discovered by Lockyer and Janssen (1868), is that the increase of the power of a spectroscope enfeebles the sky-spectrum without diminishing the brightness of the prominence-spectrum.

Doppler's principle is that a sounding or a luminous body has its pitch increased when approaching an observer, and decreased when receding from him.

Motion in the line of sight of a luminous body causes the lines in its spectrum to be displaced from their true position. By observing

the displacements of lines in prominences and sun-spots, the velocities to or from the observer are determined.

Constitution of the sun—(1) a densely gaseous nucleus; (2) solid or liquid particles (photospheric clouds) floating in an atmosphere which, by its absorption, produces the Fraunhofer lines; (3) the chromosphere and prominences; (4) the corona or coronal atmosphere.

Stars and Nebulæ.

The magnitudes of stars. Stars visible to the naked eye are classified into six magnitudes. Average first magnitude star is equal to 100 stars of the sixth magnitude. Step from one magnitude to the next, 2·51.

The brightness of a star as seen from the earth depends upon (1) intrinsic luminosity; (2) size of the luminous surface; (3) distance.

The Milky Way is composed of a large number of stars. Ninety per cent. of the stars are found in and near it. Nebulæ are most numerous away from it.

The parallax of a star is the angle subtended at the star by a radius of the earth's orbit. When found, distance in miles can be calculated.

The distances of stars are found by (1) absolute measures of position; (2) measures of position relatively to faint stars assumed to be at an infinite distance.

The proper motion of a star is the star's motion across the celestial sphere. Greatest proper motion at present known is 7″ per annum, possessed by 1830 Groombridge.

The apex of the sun's way is the point towards which the sun is moving with the planets and satellites. It is near Vega.

Variable stars are those which fluctuate in brightness. Many stars vary periodically, *e.g.*, Mira Ceti, Algol, and β Lyræ.

New stars are those which appear in a part of the sky in which no star had been previously recorded, and then fade away.

Double stars are those which can be separated into two by optical aid.

Binary stars are double stars in which a motion of revolution has been detected. These are also known as 'physical' doubles, in contradistinction to 'optical' doubles, produced by stars lying in nearly the same line at different distances.

Clusters of stars are aggregations of stars more or less concentrated towards a centre.

Nebulæ, so far as appearance goes, are masses of luminous haze. They are classified according to their forms into (1) irregular, (2) elliptic, (3) ring or annular, (4) spiral or whirlpool, (5) planetary, (6) nebulous stars.

The spectra of stars were first observed by Fraunhofer in 1814, by means of a prism over the object glass of a telescope (slitless spectroscope.)

The substances in stars were first investigated by Huggins (1864). Hydrogen, iron, calcium, sodium, and magnesium were the chief elements identified, but many others have been since found.

Four types of spectra were arranged by Secchi (1867), the division being chiefly based upon the colours of stars.

Three classes of spectra were put forward by Vogel, each divided into a number of sub-classes. The classification is based upon the idea that all the stars at one time possessed a spectrum like Vega.

Seven groups of spectra, each of which is divided into sub-groups and species, were prepared by Lockyer (1887). This grouping differs from Vogel's in recognizing that stars are increasing as well as decreasing in temperature.

The spectrum of nebulæ consists of bright lines. About fifty stars are now known to have a nebular spectrum. They are termed 'bright-line stars.'

The constitution of nebulæ is doubtful. A mass of glowing gas, or a swarm of meteorites colliding with one another, would give the observed spectrum. Hydrogen is certainly present.

The origin of the chief nebular line is doubtful. Nitrogen is not the substance, and magnesium is not generally believed to be the required element.

Stars are evolved by the condensation of nebulæ. Herschel showed that all stages of growth were to be found in the heavens, and spectroscopic evidence confirms his views.

Comets and Meteorites.

The parts of a comet are (1) the coma, or head; (2) the nucleus, usually a bright central spot, but sometimes consisting of a number of such spots; (3) the tail, generally directed away from the sun; (4) jets and envelopes, which appear to have their origin in the nucleus.

The comet of 1680 was proved by Newton to move in a parabolic orbit, thus showing that these apparently erratic bodies were subservient to the law of gravitation.

The comet of 1682 was proved by Halley to move in an elliptical orbit, making a circuit in seventy-six years. The comet's next return is in 1910.

Encke's comet moves round the sun once in 3¼ years. Its periodicity was discovered in 1819. The period is decreasing. Possible cause, a medium round the sun resisting its motion. Twenty-one comets having periods less than ten years are known.

Expected comets. Mr. Thynne Lynn, in a little book 'Remarkable Comets,' gives the following information with regard to the return of certain comets:—

Name.	*Period.*	*Date of next Return.*
Encke's Comet	3¼ years.	Winter, 1894.
Faye's ,,	7½ ,,	Spring, 1896.
Brook's ,,	7 ,,	,, ,,
D'Arrest's ,,	6½ ,,	,, 1897.
Swift's ,,	5½ ,,	,, ,,
Winnecke's	5½ ,,	Summer, 1898.
Wolf's ,,	7 ,,	Autumn, ,,
Comet of 1866	33¼ ,,	Spring, 1899.
Tuttle's Comet	13⅔ ,,	Summer, ,,
Holme's ,,	7 ,,	,, ,,

The comet of 1866 is connected with the Leonid meteors, so a rich shower of shooting stars may be expected in 1899.

Comets are captured from interstellar space by the attraction of the sun and planets.

Comets' tails are classified into (1) Straight or hydrogen tails, (2) Curved or hydrocarbon tails, (3) Stubby or metallic tails. The different forms are ascribed to the difference between gravitational attraction, and (possibly) electrical repulsion.

Shooting stars are caused by the burning of particles of matter as they rush through the earth's atmosphere. Evidence indicates that space is practically filled with such particles. Meteors are probably larger portions of matter. When the whole mass is not vaporised in passing through the atmosphere, a portion reaches the ground as a meteorite.

The radiant point of a shower of shooting stars is the point from which the luminous streaks appear to diverge. It is an effect of perspective.

Periodicity of meteor showers. More than one hundred swarms of meteorites are now known to revolve round the sun in elliptical orbits. In some cases the meteorites extend completely round the orbit in a ring, in other cases they are more condensed. Showers of shooting stars occur when the earth crosses meteor-orbits.

Comets and Meteorites. A few comets have been found to move in the same orbits as swarms of meteorites. This indicates that comets are swarms of meteorites revolving round the sun. Prof. Lockyer's spectroscopic observations give support to this idea. It cannot be logically said, however, that all comets are swarms of meteorites.

Meteorological Definitions.

The great diversity in the usage of meteorological terms by the daily press and meteorologists has induced Prof. Cleveland Abbé to state the following definitions in the *Monthly Weather Review*. Students will find that the definitions contain a large amount of information in a very concise form.

A storm is a disturbance of the ordinary average conditions, and refers to unusual phenomena, and, unless specially qualified, may include any or all meteorological disturbances, such as wind, rain, snow, hail, thunder, &c. This word may be specifically qualified by some peculiarity, that is, sandstorm or duststorm (such as the *simoom*), hot wind (such as the *khamsin*), cold wind-storm (such as the *norther*), cold rainstorm and snowstorm (such as the *blizzard*).

A hurricane or typhoon is a large stormy area, often several hundred miles in diameter, within which violent winds circulate around a centre. The centre of a hurricane or 'typhoon' is a comparatively calm region, where even the clouds break away and the rain ceases, whereas the centre of a thunderstorm is the region of greatest intensity of wind, rain, or lightning.

A tornado is a very much smaller region, usually less than two miles in diameter, within which even more violent winds prevail. In the typical tornado these violent winds circulate about a central axis, rapidly ascending at the same time and forming a funnel-shaped cloud whose base is at the average cloud level; but many destructive winds have been classed as tornadoes which are not circulating about such a funnel-shaped cloud or vertical axis, but which are either blowing straight ahead on the earth's surface, as in the 'derecho' or straight line wind, or which have a quasi-rotation around a horizontal axis, as in the blast that accompanies the front of a 'norther' or the gust in front of the heavy rain of a thunderstorm. The true tornado is rare, and should be separated from the numerous destructive winds, squalls, and gusts which are usually called tornadoes, hurricanes, cyclones, tourbillons, and other high-sounding names.

A whirlwind is any revolving mass of air, and includes at one extreme the hurricane, and at the other extreme the dust-whirl of our street corners.

A cyclone is a mass of air circulating around a centre; the lower portion of the air near the earth's surface has a vorticose movement in towards a centre, while the upper layers have a movement out from a centre; the line joining the upper and lower centres is the axis of the cyclone; the direction of rotation is the same in both upper and lower layers; in the northern hemisphere this rotation is said to be in a negative direction, or opposite to the diurnal motion of the sun in azimuth, and opposite to the movement of the hands of a watch lying with its face uppermost.

An anti-cyclone is a mass of air also circulating around a centre, but the lower layer of air has a movement out from a centre, and the direction of rotation is opposite to that of a cyclone, being positive in the northern hemisphere.

The terms cyclone and anti-cyclone do not describe phenomena that can be observed by one observer or at a single station; they should, therefore, not be used in the description of local phenomena; they represent generalizations based upon the charting and study of winds and clouds observed at many stations, and should only be used when the nature of the rotation of the winds has been clearly demonstrated or can be safely inferred.

The terms 'cyclonic winds,' 'cyclonic system,' and 'cyclonic rotation,' are equivalent to 'cyclone.' The outer portion of a cyclone generally has feeble winds and fair weather; therefore a hurricane, tornado, or whirlwind is only a small part of a cyclone.

The Causes of Earthquakes.

Strictly speaking, an earthquake or earth tremor accompanies every fall upon the earth and every readjustment of its internal mass; there is a little earthquake at the passage of every waggon, when a gun is fired, or when a tree falls. But disregarding artificial and exceptional causes and minor cases, we may roughly distinguish four main groups of possible causes of earthquakes.

(1) Of these the commonest is probably connected with change in relative level of the earth's crust, in other words, with the faulting of superficial strata. The student is probably aware that in many cases earthquakes have been accompanied by relative dropping of considerable areas of country, a phenomenon well shown in Fig. 34 of the authors' *Honours Physiography;* and even in cases where such a shifting was not perceptible, Mr. Davison has traced the centre of the vibration to the neighbourhood of faults. Hoernes, on the Continent, has also done much to direct attention to this cause—which it is scarcely too much to call *the* cause of the ordinary earthquake, at least as it is experienced in non-volcanic countries. The faulting is in all probability due to the effect of imperfectly plastic strata to adapt themselves to local or general subsidence or upheaval. A continually increasing stress between contiguous masses obtains until it is at last relieved by the rupture of the fault, and the snap of the rupture is the earthquake shock.

(2) In many cases, however, earthquakes are not accompanied by changes of level, and here, though we may hypotheticate faulting, we must suppose it occurs in deep-lying rocks as the culmination of progressive minute shifting above.

(3) In volcanic countries, however, a most fruitful cause is perhaps to be found in the sudden 'giving' of overlying strata to the upward pressure of eruptive material. It is impossible to imagine any process by which intrusive veins have been injected which would not give rise to very powerful earth tremors, and almost all important eruptions would appear to be preceded by seismic disturbance. It is probable that the causes of most earthquakes that originate under the sea is volcanic, since it would appear that faulting is confined to the continental masses (see *Honours Physiography*, p. 113). That there is an essential difference between the common land type and submarine earthquakes has also been asserted by Prof. Milne, who calls attention especially to the greater violence and destructiveness of the latter.

Coming now to minor and more occasional causes, we need only note two.

(4) *Explosions.*—These may be due to chemical reactions, or, according to those who propound this view, to percolating water coming into contact with heated rocks and 'flashing into steam.'

(5) *The collapse of* parts of the roofs of *caverns* formed by subterranean erosion. These would be a feature of limestone or salt districts.

In the cases of (4) and (5) the occurrence of the earthquakes would be independent of conditions of pressure, but it would seem probable from general considerations that variations in superficial pressure would affect earthquakes of our first three classes, and especially of those due to the cause (1). But what attempts have been made at present to correlate pressure and seismic instability have been singularly futile. This is due to the want of comprehensiveness of the observations made. Either the observer has considered the barometric pressure as a whole over the district, instead of recognising that the influential factor must be not the pressure as a whole but local difference in pressure, or attention has been exclusively confined to other agents affecting the crust stability.

Thus we read in Geikie's *Text Book of Geology* that the two chief earthquake maxima occur at new moon and *two days after the first quarter*, and a minimum on the day of the last quarter. Taken by themselves, without any attempt to classify the earthquakes recorded, such maxima and minima are absolutely unmeaning. It must, however, be clearly understood that though the relationship has still to be formulated, some clear sequence of cause and effect must obtain between the agents of the tidal stresses and seismic impulses.

Rock Joints.

A considerable amount of enquiry still remains to be disposed of with regard to the causes of rock jointing. We may remind the reader that joints are vertically disposed planes dividing up the masses of rocks. Usually we find one set parallel to the dip of rocks (dip joints), and another at right angles to these (strike joints). The planes of division may be so fine, as in limestone, coal, and some clays, as to be invisible until the rock is fractured or weathered, or they may be clearly apparent as great cracks in coarser rocks. For teaching purposes joints may be beautifully shown in a lump of common coal. The separation will frequently continue in the same plane for considerable distances, even for miles, but tortuous joints sometimes occur. In some coarse conglomerates the joint planes will cut right through pebbles that lie across their course.

To this brief description we may add a very significant fact, that joints gradate insensibly into faults. There are separations in rock masses which a geologist would hesitate to classify whether as fault or joint. Some joints like faults may have their opposite faces 'slickensided,' that is, grooved and striated by their mutual movement over one another.

The following are the chief causes that have been advanced to account for jointing. Not one of them appears to be an altogether satisfactory explanation.

(1) In the first place, there is the hypothesis that the rocks have altered in temperature, and that joints have arisen through their consequent *contraction.* But on this supposition joints should be gaps, rather than cracks with closely apposed walls, between the rock masses. Besides this, contraction seems in other cases to result in 'perlitic,' 'ball and socket,' and hexagonal column structure, rather than in a division into cubical masses such as is generally manifest in jointing.

(2) Another view is that jointing is due to a process of compression similar to that which has produced cleavage. But it is difficult to see how compression should eventuate in vertical planes of separation mutually at right angles.

(3) Daubrée, who has done so much for geological theory by his brilliant experiments, has succeeded in producing joint planes in various rock-like substances by means of an undulating motion and movements of torsion in their mass. No doubt his work has a very immediate bearing upon this problem. Alone, however, it is inadequate, since Gilbert has described the existence of joints in recent and quite undisturbed layers of clay from the dried up Sevier Lake of Utah.

(4) Another and very plausible hypothesis is that of Crosby, who would account for jointing by the passage of earthquake waves, but here again the difficulty arises of why they should usually run as dip joints and strike joints mutually at right angles.

(5) Or, finally, joints may, like faults, be most immediately connected with the internal shifting in the mass that must accompany the elevation or depression of any considerable body of strata.

Intrusive Veins and Dykes—'Composite Dykes.'

Prof. Judd has recently published in the Quarterly Journal of the Geological Society an account of certain dykes displaying a banded structure, the external rock being of a different species to that constituting the core of the dyke. We may here give a few notes on the general constitution of dykes and intrusive veins, and add a word or two concerning these composite dykes.

The word *vein* is used rather vaguely by geologists to indicate either any crack in a rock mass filled with dissimilar material, or any band of dissimilar material in a rock. *Mineral veins* are cracks and fissures filled with material either brought in solution by infiltrating water or sublimated from below, and we may very conveniently put these aside. This leaves us cracks injected with igneous rock which are spoken of as *Intrusive Veins*, and what are called '*Contemporaneous*' and '*Segregation*' veins, to be described below. Intrusive veins branch and bend through the strata they have ruptured. When these walls are vertical and their thickness fairly uniform, they are spoken of not as 'veins' but *dykes*, a Scotch word meaning wall.

In masses of igneous rocks bands of dissimilar minerals may occur which are apparently due to rupture and injection before the final consolidation. Such bands are intimately interfused with the rock in which they occur, and are spoken of as 'contemporaneous veins.'

'Segregation veins' are apparently formed in the substance of rocks without any previous fissure occurring, by a gradual process of interchange of material, whereby one mineral becomes predominant along the course of the vein. Their formation is analogous to the growth of flints in limestone. They occur not only in igneous rocks but in the crystalline schists, and even in sedimentary rocks.

We may tabulate these different forms of veins as follows:—

(*a*) Rock Veins.
  (i.) Intrusive subsequent to the formation of the surrounding rock (including Dykes).
  (ii.) Contemporaneous Veins.
  (iii.) Segregation Veins.
(*b*) Mineral Veins.

What are called 'Pegmatite' or 'Giant granite' veins are bands of rock with very coarse felspar traversing granite. It is doubtful if they are to be considered as segregation or contemporaneous veins.

'Composite' Dykes appear to be of fairly common occurrence in Cornwall. A common type, according to Mr. Ede, consists of alternating layers of granite (felspar, mica, and quartz) and schorl rock (tourmaline and quartz). In many cases these composite dykes have the appearance of a dyke within a dyke, as though when solidification was some way advanced the fissure had been further widened and fresh material of dissimilar composition had been intruded. But the type described by Mr. Ede is scarcely to be accounted for by subsequent widening and new injection.

NOTES ON PHYSIOLOGY:

EMBRACING THE SYLLABUS (ADVANCED AND HONOURS STAGES) OF THE SCIENCE AND ART DEPARTMENT.

BY WALKER OVEREND, M.B. (OXON.), B.SC. (LOND.).

22. *The Rhythm of the Heart.*—When the heart of a rabbit is removed from the chest, *immediately* after the animal is killed, under favourable circumstances it may beat for ten minutes. The heart of a frog or tortoise thus removed, may go on beating for days if kept moist by means of a weak solution of common salt. If required also, the beat of the heart may be then registered upon a travelling surface. Their are several ways of doing this.

(1) A light lever may be placed upon the ventricle and provided with a writing point; at every beat of the heart the lever rises, and will describe a curve upon a travelling surface, if the latter has been blacked beforehand.

(2) The heart may be held vertically upward by means of a clamp in the auriculo-ventricular grove, a threaded needle is pushed through the apex of the ventricle, and the ends of the thread brought down and fastened to a light lever beneath. At every contraction of the heart the lever rises.

(3) In another method the *changes in volume* of the heart are registered. A small metal tube is tied into the heart; and the tube contains an inner tube, connected with a small bulb containing *fluid*. The fluid enters the ventricle and is driven out through the outer tube when the ventricle contracts. The ventricle lies in an air-tight chamber containing oil. Every time the ventricle contracts it becomes smaller in volume, and the pressure within the oil chamber becomes less. The oil chamber is connected with a very light piston, with a thread attached to the outer end, passing to a light lever. The piston therefore moves up and down in accordance with changes in volume of the oil chamber, and registers them.

23. The fluid entering the heart must contain a certain amount of oxygen. It is better also that it should be alkaline, since the heart produces during contraction a relatively large quantity of lactic acid, which must be neutralised, otherwise the heart will stop. The heart may be kept beating for hours, if the fluid contains a trace of calcium chloride, a trace of potassium chloride, and a little sodium bicarbonate, all these being dissolved in *normal* salt solution, that is, a solution of common salt, equal to about 0·6 per cent. Pure normal salt solution will not suffice—the heart stops. But after it has stopped, the addition of a small quantity of peptone or blood serum will cause the beats to recommence.

24. *The cause of the Rhythmic Movement.*—Since the heart beats when removed from the body and when deprived of blood, the cause of its rhythm must lie in itself, that is, it is *automatic*. The beat of a frog differs from that of a mammal, in the fact that it possesses a venous sinus, into which the large veins enter. There are then two auricles and but *one* ventricle. The muscular fibres are somewhat spindle-shaped and are striated transversely. The heart of a frog also contains many nerve fibres and ganglion cells, and for many years the power of rhythmic movement was attributed to the presence of these ganglion cells. For instance there is a collection of ganglion cells in the venous sinus, and two collections of cells in the auriculo-ventricular grove, called Bidder's ganglia. In the lower two-thirds of the ventricle of the frog, ganglion cells, however, are not present. If the heart be ligatured tightly at the junction of the venous sinus with the auricle (ligature of Stannius), both auricles and the ventricle stop instantly and become quite flaccid, but the venous sinus continues to beat. After about thirty minutes, however, the auricles and ventricle recommence. If then, the auricles be separated from the ventricle by means of a sharp knife, the auricles continue to beat, while the ventricle soon stops; but after a time it recommences to beat, but the beats are very slow. It was supposed that the separation of the ganglion cells in the venous sinus was the cause of the stoppage of auricles and ventricles after Stannius' ligature, but that after a time Bidder's ganglia undertook the function of rhythmic movement. It is now known, however, that the rhythmic power lies in the muscular fibres themselves. Since if these three collections of ganglia be very carefully removed, the heart still goes on beating as before. Moreover a strip of the muscle of a tortoise's ventricle, containing *no* ganglion cells, if placed in a small box and kept moist, can be made to beat of its own accord, and will beat for hours. It it evident, therefore, that the rhythm must be due to a property of the muscular tissue itself. In all probability the process is similar in the heart of the rabbit and of man, but the hearts of mammals do not lend themselves so easily to experiment, since they die much more quickly after removal from the body.

25. *The Cardiac Nerves.*—Under the influence of certain emotional states the heart of man may begin to palpitate, or it may suddenly stop in diastole. Two sets of nerves reach the heart from the central nervous system—the vagus nerves, and the sympathetic. The sympathetic fibres run from the spinal cord through the anterior roots of the spinal nerves, and to the ganglia of the sympathetic, and thence pass to the heart. The cardiac fibres of the vagus in reality reach the latter through the spinal accessory nerve. When these nerves are stimulated by the electric current from an induction coil, different effects are produced. If the vagus be stimulated, the heart *stops* almost immediately, and resumes its contraction gradually, after the current is taken off. In other words, stimulation of the vagus is said to *inhibit* the heart. Stimulation of the sympathetic, on the other hand, increases the strength of the contractions, and quickens them. These are therefore called *accelerating* nerves. Besides these nerve-fibres which carry impressions *to* the heart (efferent or motor), there are other fibres in the vagus, which carry sensory impulses *from* the heart to the central nervous system. Possibly these fibres may carry the sensation of pain under certain circumstances.

26. Besides the electric current, also the vagus is sensitive to pinching, and to certain chemical substances, as a concentrated solution of salt. The fibres proceed from a collection of cells in the medulla oblongata, called the inhibitory centre of the vagus. The centre may be called into action reflexly. Severe pain in any region of the body, especially the abdomen, may affect the centre and stop the heart. It may also be stimulated from the nose; for instance, strong ammonia applied to the nose of a rabbit will arrest the heart. In some animals, the vagus appears to exert a constant restraining influence on the heart, for if the two vagi of a dog be cut the heart-beats at once increase in speed.

27. *The action of Atropin.*—The alkaloid prepared from belladonna is most interesting. If the heart of a frog be brushed over with a solution of atropin, it is found that stimulation of the vagus is then powerless to produce stoppage of the heart. In the same way, if a solution of atropin be injected beneath the skin of a rabbit, the vagus is again rendered impotent. Muscarin, on the other hand (to which atropin is the antidote), causes slowing of the heart, and final arrest. It is said to stimulate the ends of the vagus within the heart, and thus induce stoppage.

28. *The Vaso-motor Nerves.*—In the same way as the heart, the blood vessels also are supplied by two sets of nerves. When the sympathetic nerve in the neck of a rabbit is cut through, and the ear held up to the light, the latter is seen to become quite red, and many little vessels of the ear start up where no vessels had been previously visible, and the ear becomes warmer. If the end of the

cut nerve, which still remains in connection with the ear, be stimulated by the electric current, the ear becomes quite pale, in fact much paler than normal. When the nerve was divided, the arteries dilated, evidently because some restraining or constricting influence had been removed. We have already said that the nerves going to the arteries pierce the outer coat and end in the muscular fibres of the middle coat. These muscular fibres are arranged in the form of a ring. In speaking of arteries, it was mentioned that they are endowed with *elasticity*. This is purely a physical property, so that arteries possess it after death. The other property of *contractility* is imparted to them by virtue of their annular muscular fibres. During life this is usually kept in a moderate state of contraction, in other words, the arteries are said to possess *tone*, and indeed when the general centre in the medulla, from which all these vascular nerves arise (vaso-motor centre), is stimulated, all the arteries in the body dilate. The tone may be modified in two directions. It may be either increased or diminished. Impulses producing these effects are carried by the nerves of the vessels—the so-called vaso-motor nerves. There are therefore two kinds of vaso-motor nerves—*vaso-constricting*, which lessen the lumen of the vessel, and the *vaso-dilating nerves*, which restrain or inhibit the normal tone of the vessels and so produce dilatation.

29. *The Vaso-dilating Nerves.*—The best example is found in the chorda tympani nerve, which springs from the facial nerve, runs through the tympanic cavity of the ear, and then joins the gustatory branch of the third division of the fifth cranial nerve, and sends branches to the submaxillary and sublingual salivary glands. When the chorda tympani is divided, nothing happens; but if the cord in connection with the submaxillary gland is stimulated, the small arteries of the gland dilate, and, in fact, the whole gland becomes flushed with blood, at the same moment much saliva is secreted, though this fact at the present time is not important to us. Evidently the chorda tympani contains vaso-dilating fibres. We have already mentioned the sympathetic nerve in the neck as a good example of a vaso-constricting nerve. But in most places in the body these nerves run side by side in the same nerve-trunk, as in the nerves of the limbs.

30. Certain nerves in the abdomen, called the *splanchnics*, proceeding from the sympathetic chain, to supply the viscera and the blood-vessels, also contain vaso-constricting fibres, and when they are divided, all the blood-vessels of the abdomen dilate, and blood pressure falls. The blood-vessels within the muscles of the limbs are supplied by vaso-motor nerves, which contain vaso-dilating fibres chiefly; and whenever the motor nerve going to a muscle is stimulated, beside the contraction of the muscle, there is a dilatation of its blood-vessels at the same time, which is of use, since more blood is brought to the muscle just at a time when it is required, and more blood leaves the muscle, and therefore helps to carry away the products of contraction, which, if they accumulate, produce weariness and loss of power.

31. Just as excessive stimulation of any sensory nerve may affect the heart, so the same process may influence the vaso-motor centre and the condition of the blood-vessels. Everyday experience teaches us this: witness the pallor of the face produced by pain. If this way the vaso-motor centre may be affected reflexly. If the sciatic nerve be laid bare, and the central end—that is the upper end—stimulated, the blood-pressure rises, and this is due to constriction of the blood-vessels. In this experiment the animal is under the influence of chloroform.

32. We now pass on to speak of an important nerve called the *depressor*. This is a very delicate nerve, a branch of the vagus, passing also to the heart. When this small nerve is cut and the end in connection with the medulla oblongata is stimulated, the blood pressure falls enormously. It may sink to one-half of what it was before. At the same time the blood vessels of the abdomen become engorged with blood. How is this? Evidently impulses have passed along the depressor to the medulla and have inhibited that portion of the vaso-motor centre which keeps up the tone of the abdominal blood-vessels by means of the splanchnics, and the effect is the same as if the latter nerves had been divided. The depressor nerve has been termed the safety-valve of the heart, for should the heart beat too quickly and too powerfully, the high pressure within the heart would stimulate the ends of the depressor and induce a lowering of blood-pressure, and so relieve the heart.

33. Stimulation of the brain may also influence the blood-pressure by the same means. Mental excitement, the seat of which lies in the cerebral hemispheres, may induce blushing or pallor. Blushing is due to a local dilatation of the arteries, with redness and increased warmth of the skin. Blushing is by no means confined to the face, and may occasionally occur on the neck, chest, and arms. Terror or great anxiety in rabbits may produce pallor of the ears. Pallor is the opposite condition, and is due to a local constriction of the blood-vessels.

34. With regard to the *influence of the nervous system on blood-pressure* we can thus sum up what we have learnt:

(*a*) Stimulation of certain nerves, as the sciatic, or the nerves of the arm, induces a rise of blood-pressure, and this is due to sensory impulses passing up to the vaso-motor centre and influencing certain vaso-constricting nerves.

(*b*) Stimulation of the central end of the depressor nerve induces a great fall of blood-pressure, also reflexly.

(*c*) Stimulation of the vagus induces a fall of blood-pressure, because it slows and finally stops the heart, and the contraction of the latter is the chief means by which the blood-pressure is maintained.

35. The exact *position* of the *vaso-motor centre* has been determined in rabbits. Since stimulation of various nerves in the body induces in a reflex manner an increase or diminution of blood-pressure, as the case may be, there must be some centre in the central nervous system by which the effects of stimulation of sensory nerves are transmitted to the arteries. By application of the fact mentioned above, that stimulation of various nerves affects arterial pressure, we have a means of determining the locality of the vaso-motor centre. We have to remove parts of the brain from above downwards, until stimulation of the sciatic nerve, for instance, produces no further effect on blood-pressure. To prevent any pain, an anæsthetic, as chloroform, is given, and curare is injected into the circulation to prevent any movement of the muscles. The centre is thus found to be in the upper part of the medulla oblongata and to extend partly into the Pons Varolii.

MODERN EDUCATIONAL REFORMERS.

BY THOMAS CARTWRIGHT, B.A., B.SC. (LOND.),

Author of 'Mental Science and Logic for Teachers,' etc. Late Co-Director of the Birkbeck Training Classes for Teachers.

V.—ALEXANDER BAIN, LL.D.

THE inclusion of Prof. Bain in this series will need no apology to those who are familiar with the work of this acute and original thinker. To those who are not in touch with the worthy Professor's career we would quote Quick as to the value of theorists, amongst whom we should fitly place the reformer in question. 'I once heard it said by a teacher of great ability that no one without practical acquaintance with the subject could write anything worth reading on Education. My own opinion differs very widely from this. I am not, indeed, prepared to agree with another authority, much given to paradox, that the actual work of education unfits a man for forming enlightened views about it, but I think that the outsider, coming fresh to the subject, and unencumbered by tradition, may hit upon truths which the teacher, whose attention is too much engrossed with practical difficulties, would fail to perceive without assistance, and that, consequently, the theories of intelligent men, unconnected with the work of education, deserve our careful and, if possible, our impartial consideration.' This statement, if acceptable, at once establishes Prof. Bain's claim to our earnest and thoughtful attention, for he is entitled to high rank amongst the men who have thought much and well on matters educational. Howbeit, let it not be supposed that Bain has had no practical experience, for, as will be seen from what follows, teaching has engrossed much of our subject's attention; but we are constrained to sit at our reformer's feet mainly because of the sagacity and earnestness which he exhibits in his 'Education as a Science.' In this respect he

resembles Spencer, whose claim to attention rests upon the fact that he wrote his essays on 'Education.'

Bain is essentially a man of Aberdeen. Here he was born in 1818. Here he was educated, graduating in 1840. In 1845 he left his native city, having been appointed Professor of Natural Philosophy at the Andersonian University of Glasgow, which post he retained for a few months only. He was in 1847 given the post of Assistant Secretary to the Metropolitan Sanitary Commission, and passed on to the same post to the General Board of Health in 1850. Ten years later Aberdeen reclaimed her talented son, who had already, by the publication of 'The Senses and the Intellect,' in 1855, and, later on, 'The Emotions and the Will,' conclusively established his claim as one of the most profound and original grapplers with the science of mind that modern times has produced. He was given the post of 'Regius Professor of Logic' in Aberdeen University, and twice, viz. in 1881 and in 1884, has he been elected Lord Rector of his *alma mater*. The prophet has, therefore, for once in a while not been without honour in his own country. Besides the two works above referred to, Prof. Bain has given to the world his 'Mental and Moral Science,' 'Logic Deductive and Inductive,' 'Mind and Body,' 'English Grammar,' 'English Composition and Rhetoric,' and 'Education as a Science.' In each and every of these books perspicuity and originality are abundantly apparent, whilst to say that our author is characterized by breadth of view is to state a fact which stands out from every page of his works. To 'Mind,' the organ of English psychological thought, Prof. Bain contributes much valuable matter. Of both James and John Mill he was an intimate friend, to which friendship we are indebted for two interesting biographical sketches of Mill senior and junior respectively, which Bain's prolific pen has provided for 'Mind.' It is possible that it was his association with the Mills that turned his thoughts to the consideration of the problem of education, for both these men were much exercised in their minds as to the proper education of the masses. Be this as it may, 'Education as a Science' shows most clearly that Bain has given sufficient time and attention to educational matters to place him in the front rank of thinkers on this all-important subject. This we proceed to establish by a careful examination of the work in question.

The two great facts to note as special features in this book are (1) that mental science is connected with teaching rules, which are thus shown to be in accord with mental development; (2) the curriculum is systematically examined with the view of discovering how far it is suited for the great business of mind development.

These two points may seem unimportant, but a little reflection shows that practical teachers may here learn of the theorist, for rule of thumb still rules the roast, and few teachers can even now give reasons for their practices by reference to the acknowledged laws of psychology. Bain would have teaching in line with science by making it *applied psychology*. And with regard to the second point, it is still rigidly true that subjects are taught without any consideration of their value in use, but merely because they are prescribed by authority or tradition. So that even now, fifteen years after the issue of his book, Prof. Bain is still ahead of the majority of us. That his contention is true a mere glance at one or two pages of his book will show, *e.g.* (p. 23), 'the plastic or retentive function is the *very highest energy* of the brain. To drive home a new bent, to render an impression self-sustaining and recoverable, uses up more brain force than any other kind of mental exercise. The moments of susceptibility to the storing up of knowledge, to the engraining of habits and acquisitions, are thus the moments of the maximum of unexpended force. The circumstances need to be such as to prepare the way for the highest manifestations of cerebral energy; including the perfect freshness of the system and the absence of everything that would speedily impair it. . . . For two or three hours after the first meal the strength is probably at the highest; total remission for another hour or two, and a second meal (with physical exercise when the labour has been sedentary), prepare for a second display of vigour, although not equal to the first, except in youthful years; when the edge of this is worn off, there may after a pause be another bout of application, but far inferior in result to the first or even the second. No severe effort should be attempted in this last stage, although routine efforts may be kept up.'

Sydney Smith's far-seeing saying, 'If you make children happy now, you make them happy twenty years hence, by the memory of it,' is quoted with approbation; and it is pointed out that these happy associations are of slow growth, whilst the depressing associations of terror are quickly acquired. As to the cruelty of punishments that terrorise, Bain says truly, 'the worst of all modes and instruments of discipline is the employment of spiritual, ghostly, or superstitious terrors. Unless it were to scourge and thwart the greatest of criminals, hardly anything justifies the terrors of superstition. Still, a good word must be said for that refined mode of the emotion 'as shown in the fear of giving pain or offence to one that we love, respect or venerate. There may be a considerable degree of the depressing element even in this situation; yet the effect is altogether wholesome and ennobling. *All superiors should aspire to be feared in this way.*'

In the same way, albeit that the emotion of anger is one to be severely let alone by the teacher, there is a place for its refinement, for 'the function of anger in school discipline may be something very grand provided that passion can be controlled. There is a fine attitude of indignation against wrong that may be assumed with the best effect. It supposes the most perfect self-command, and is no more excited than seems befitting the occasion. Mankind would not be contented to see the bench of Justice occupied by a calculating machine that turned up a penalty of five pounds or a month's imprisonment when certain facts were dropped in at the hopper. A regulated expression of angry feeling is a force in itself. Neither containing fitfulness, nor conducting to excess of infliction, it is the awe-inspiring personation of Justice, and is often sufficient to quell insubordination. Another rule which should be 'writ large' in every school-room is that 'a pleased smile is a great moral influence,' and respecting dispraise or depreciation the following is equally true and weighty: 'People live so much on one another's good

opinion that the remission tells in an instant; for the simple abatement or loss of estimation there is a descent into the depths of disesteem with a result of unspeakable suffering. The efforts that the victim makes to right himself under censure only show how keenly it is felt. There can be little doubt that on the delicate handling of this instrument must depend the highest refinement of moral control."

Per contra, it is to be noted that Prof. Bain does not dot the i's and cross the t's of those who, like Pestalozzi, Froebel, Spencer, and the rest affirm, that children's questions are indicative of innate curiosity, which should be utilised to the full. The curiosity is a spurious article, and the questions are the result of what our American cousins graphically, if not euphemistically, term 'cussedness.' 'Much of the curiosity of children, and of others besides children, is a spurious article. Frequently it is a mere display of egotism, the delight in giving trouble, in being pandered to and served. Questions are put, not from the desire of rational information, but from the love of excitement . . . The so-called curiosity of children is chiefly valuable as yielding ludicrous situations for our comic literature.' Few teachers will hold with Prof. Bain in maintaining this position; but when he tells us that 'a great discovery has been made in regard to punishments by the enunciation of the maxim that *certainty is more important than severity*,' his theory will accord with the practice of most of us. Whenever the reasons for a rule can be understood, they should be firm, says Bain, and he also lays down the following points of agreement in the exercise of authority in every sphere :—

(1.) Restraints should be as few as the situation admits of.
(2.) Duties and offences should be definitely expressed so as to be clearly understood.
(3.) Offences should be graduated according to their heinousness.
(4.) Voluntary dispositions are to be trusted as far as they can go.
(5.) By organisation and arrangement the occasions of disorder are to be avoided.
(6.) The awe and majesty of authority is maintained by a certain formality and state.
(7.) Authority exists for the benefit of the governed and not for that of the governing.
(8.) The operation of vindictiveness should be curtailed to the uttermost.
(9.) By instruction and moral suasion the necessity of force should, as far as possible, be staved off.
(10.) The reasons for repression and discipline should be made intelligible to those concerned, and should be referable solely to the general good.

The teacher's personality is regarded from a twofold aspect: (1) the side of allurement or attraction, consisting of 'a likeable exterior, a winning voice and manner, a friendly expression when relaxing the sternness of authority'; (2) the stately, imposing, and dignified bearing by which one can impersonate authority and be a standing reminder to the evil disposed of the flock. 'It is seldom,' observes Bain with truth, 'given to one man or woman to display both attitudes in their highest force; but wherever, and to whatever extent, they can be assumed, they constitute a barrier to disaffection and remissness. Any prominent displays of swagger and self-conceit operate against the teacher's influence, and incite efforts to take him down. It is possible to temper authority with an unassuming demeanour. Again, 'that quietness of manner which comes not of feebleness, but of restraint and collectedness, passing easily into energy when required, is a valuable adjunct to discipline. To be fussy and flurried is to infect the class with the same qualities.'

Many teachers despair because they have not the class opinion on their side. To them the following will be grateful: 'The fear is that to the end of time the sympathy of numbers will continue to manifest itself against the authority in the school.' And to those believers in the infallibility of the milk of human kindness and moral suasion, this acute thinker and world-famed logician says, 'He may still work by soothing applications, gentle and kindly remonstrance, he may check the spread of disaffection by watchful tactics, and by showing that he has the ringleaders in his eye, *but in the end he must punish*.' 'It is this position of constant preparedness for disorder, sometimes in isolated individuals and sometimes in the mass, that demands an air and manner betokening authority, and carrying with it a certain hauteur and distance, the necessity for which is the stronger as the warring elements are more rife.' The defects of the practice described as emulation, prizes, and place-taking, are—(1) It is an anti-social principle; (2) it is apt to be too energetic; (3) it is limited to a small number; (4) it makes a merit of superior gifts.

That 'loss of temper, however excusable, is really a victory to wrong-doers, although for the moment it may strike terror,' is a doctrine to which all will subscribe, as also to the equally patent principle that 'it is mere impotence to utter threats when the power of execution is known to be wanting. There is nothing worse for authority than to over-vaunt itself; this is the fatal step to the ridiculous.' As to recalcitrant pupils, Prof. Bain thus delivers himself: 'The presence of pupils that are not amenable to such (ordinary) means is a discord and an anomaly; and the direct remedy would consist in removing them to some place where the lower natures are grouped together.' That this is a desirable consummation nobody with experience of a school in a slum will deny. Surely if truants, who do not injure the school so much as they injure themselves, are expelled and isolated, it should be possible to deal similarly with the small minority of young blackguards, whose presense among children of reasonable dispositions is a standing danger, should be enabled to leave their school for their school's good. The possibility of such expulsion would constitute a powerful instrument wherewith to repress the worst forms of school vice, but, as our author adds, 'the misfortune is that in the National Schools the worst and most neglected natures have to be introduced' and, it may be added, retained.

Passing on to deal with the discipline of consequences, our reformer agrees that the consequences are frequently too serious and too remote to be efficacious, whilst the striking lack of foresight and foreknowledge in children is another bar to the action of this ideal scheme of punishment recommended by Rousseau and lauded by Spencer. We cannot follow

the explanation and illustration of such terms as Cultivation of Memory and Judgment, Imagination from the Known to the Unknown, Analysis and Synthesis, &c. Suffice it to say that such explanation as is absolutely necessary is given in language appropriate and clear enough to be read running. Much more important is the interesting chapter which deals with 'Education Values,' which is a glance at the leading branches of human culture with a view to seize the characteristic mental efficacy of each. This is one of the most valuable contributions to the science of education, and has drawn from Prof. W. H. Payne, of America, the well-deserved encomium which follows: 'Mr. Bain devotes the fifth chapter of his 'Education as a Science' to the discussion of education values, and the same subject is favoured, in an informal way, in subsequent portions of his work. These discussions are characterised by largeness of view, catholicity of spirit, and eminent judicial fairness. The critical reader cannot fail to be impressed with the conviction that the author has emancipated himself from prejudice, and is in the zealous pursuit of truth for truth's sake. In the main, Mr. Bain's discussion of education values is the application of common-sense to the evolution of this complex problem. He marks the distinction between studies that end in useful information and studies that end in mental discipline, and holds that the practical sciences contribute but little to mental training. . . . Mr. Bain's treatment of this theme has a large, substantial value, and is doubtless the ablest contribution that has been made to the discussion of this historic problem.' The *modus operandi* is sketched out in these words: 'The carrying out of our design involves a full consideration of the two leading departments, Science and Language. These comprise the great mass of human information in its purest types, and should be thoroughly appraised before entering upon mixed subjects such as Geography and History. Fine Art will be touched upon, and the mere mechanical acquirements, as Drawing and Handicraft, will be considered in their subservience to Intellectual Education.'

(I.) The Sciences (*a*) constitute the most perfect embodiment of truth and exemplify the devices for establishing a fact, or a law, under every variety of circumstance; (*b*) their great liberalising feature is the mode of setting forth general or generalised knowledge. For his purpose, Prof. Bain. divides the sciences thus:—

Sciences.

Abstract and Demonstrative = Mathematics.	Experimental Sciences = Physics. Chemistry and Physiology. Natural History (Classification).	Science of Mind.

(1) Abstract sciences yield eminent practice in *deduction*. The rigid definition of all leading terms and notions; the explicit statement of all the first principles; the onward march by successive deductions, each one reposing on ground already secured; no begging of either premisses or conclusions; no surreptitious admissions; no shifting of ground; no vacillation in the meaning of terms—all this is implied in the perfect type of a deductive science. On the contrary, mathematics does not teach us how to observe, how to generalise, how to classify. It does not teach us the prime art of defining by the examination of particular things.

(2) Experimental Science. Here the precautions for arriving at truth by observation and experiment attain their highest exemplary force and the best methods of inductive generalisation are afforded, and we are taught how far empirical and limited generalities are to be trusted. Not only are they at the basis of many special crafts, but they provide guidance in endless situations.

(3) Science of Mind. If approached after preparation in the foregoing sciences, psychology will superadd a discipline of its own, while extending the quality and quantity of our mental knowledge. The Practical Sciences (Navigation, Machinery, Engineering, Metallurgy, Agriculture, Medicine, Surgery, and War—related to Physics and Politics—Ethics, Law, Grammar, and Rhetoric—related to the Science of Mind) have no purpose beyond their immediate application. None of them can be accounted sciences of Method, Discipline, or Training.

(II.) Languages. Their main, if not their sole, justification is that we mean to use them as languages to receive and impart knowledge by their means. This, of course, tells against the teaching of dead languages to ordinary scholars.

Of Drawing and Kindergarten occupations Prof. Bain has little appreciation, but he gives a most valuable section on the Object Lesson, which commences with an enumeration of the dangers to be avoided:—(1) Superfluous communication, telling children what they already know; (2) assuming what is not yet intelligible to the pupil; (3) unseasonable digression; (4) lack of consecutive arrangement. He further recommends that 'uses' should be given after the more obvious aspects have been observed. But we have overstepped our space, and cannot pursue this interesting book further. The inquisitive reader will find detailed discussions of the individual subjects of the curriculum fraught with suggestions and replete with wisdom, and adding further to Prof. Bain's reputation as an enlightened educational reformer.

CIRCULAR TO H.M. INSPECTORS.

Age of Exemption from School Attendance.

Education Department, Whitehall, London, S.W.,
16th December, 1893.

Sir,—I am to enclose for your information a copy of a Circular which is now being issued to all School Boards and School Attendance Committees in England and Wales, explaining the alteration in the age of exemption from school attendance which has been made by the Elementary Education (School Attendance) Act, 1893.

My Lords consider it of the highest importance that the change in the law should be well understood throughout the country, and they desire that you should do everything in your power to make it known among managers, teachers, and scholars.

If you have reason to believe that any particular School Boards or School Attendance Committees are administering the Education Acts and local Bye-Laws without reference to the change made by the recent Act, I am to request that you will communicate the fact, together with evidence in support of it, to the Department.

I have the honour to be, Sir, your obedient servant,
G. W. KEKEWICH.

To H.M. Inspectors of Schools.

CIRCULAR TO SCHOOL BOARDS AND SCHOOL ATTENDANCE COMMITTEES.

Age of Exemption from School Attendance.

Education Department, Whitehall, London, S.W.
16th December, 1893.

SIR,—My Lords think it desirable to call the attention of all Local Authorities under the Education Acts to the alteration in the law of School Attendance made by the 'Elementary Education (School Attendance) Act, 1893,' which will come into operation on the 1st of January next.

Shortly stated, the effect of the Act is to raise to 11 years the minimum age for exemption (whether total or partial) fixed by local bye-laws made under the Education Acts. Consequently any bye-laws now in force in the district of your School Board or School Attendance Committee, which may provide for the total or partial exemption of children from the obligation to attend school on attaining the age of 10 years, or some lower age, will, after the 1st January next, be construed and have effect as if the minimum age for exemption were 11 years. This alteration in the bye-laws is made automatically by the Act, and it is not necessary to make fresh bye-laws and submit them to the Department for approval. Parents will be liable to conviction under the bye-laws, if they fail to cause their children between 5 and 11 years of age to attend school, notwithstanding that the bye-laws as they now stand, provide for exemption of children after 10 years of age. In all new sets of bye-laws the provisions for exemption from school attendance, whether total or partial, must be restricted in their operation to the case of children over 11. Meanwhile it is highly desirable that every copy of the existing bye-laws, which is used or issued after the 1st of January next, should contain a note or statement calling attention to the alteration in the age for exemption. A suggested form of note is printed at the end of this circular. (*Section* 1.)

The Act contains a section forbidding, under penalty on the employer, the employment of any child in such manner as to prevent its attending school in accordance with the bye-laws for the time being in force in the district in which the child resides. The penalty is a fine not exceeding forty shillings, and is the same as that prescribed in section 6 of the Elementary Education Act, 1876, for a contravention of that Act. (*Section* 2.)

In order to avoid any hardship on parents whose children were at the passing of the Act qualified for employment under the bye-laws then in force, the Act contains a special provision to meet such cases. Any child who, on the 22nd of September last (the date of the passing of the Act), had attained the age, and reached the standard fixed by the bye-laws in force in the district in which he was then residing for total exemption from school attendance, may continue to be employed full time after the 1st of January next, notwithstanding that he may be under 11. Similarly any child who on the 22nd of September last was entitled to partial exemption from attendance at school, may continue to be employed as a half-timer, though he may be under 11; but he will not be qualified for full-time employment till he has completed his 11th year, even though he reach the full-time standard before attaining that age. Children under 11, who have under the existing law become qualified for total or partial exemption since the 22nd of September last, will cease to be so qualified on and after the 1st of January next. (*Section* 3.)

It will be noted that the effect of the Act is to lessen the hitherto existing discrepancy between the conditions of employment under the Factory Acts and those under the Education Acts. Under the Factory Acts no child under 11 may be employed in a factory or workshop. Under the Education Acts no child under 11 may, after the close of the year 1893, be employed, except in the special cases mentioned in Section 9, Sub-Sections (1) and (2) of the Act of 1876.

My Lords hope that all Local Authorities, whether School Boards or School Attendance Committees, will take the earliest opportunity of making known in their districts the changes in the law effected by the Act of 1893, and described in this circular; and that they will use their best endeavours to secure that the provisions of the Act are properly understood by parents and employers, and that the laws regulating school attendance are strictly and universally enforced.

I have the honour to be, Sir, your obedient Servant,
G. W. KEKEWICH.

Suggested FORM of NOTE to be appended to existing BYE-LAWS.

In such of the above Bye-laws as provide for the total or partial exemption of children from the obligation to attend school, the age of *eleven* years is, by the operation of the Elementary Education (School Attendance) Act, 1893, substituted for the age of *ten*, or for any age lower than *eleven*.

BRITISH MUSEUM 25DE93

PRIZE BOOKS.

MESSRS. BLACKIE AND SON'S LIST.

(SECOND NOTICE.)

A Champion of the Faith. A Tale of Prince Hal and the Lollards. By J. M. Callwell.

The tale in this attractive volume gives a clear idea of the religious state of England in the reign of Henry IV., when madcap Prince Hal was indulging in his pranks. The conversion of Sir John Oldcastle—one of the Prince's chief favourites—to the new faith, and his subsequent arrest and martyrdom, is a story that Christian England's boys and girls should all know. The life sketch of Lord Alyen Powys, who was changed at birth and brought up as only the miller's son, gives a colouring of old-time romance to this true history. The book will be read with avidity by young people of both sexes.

The White Conquerors of Mexico. By Kirk Munroe.

The entrance of Cortes into Mexico's royal city, the overthrow of the heathen gods and destruction of their temples, are the main features of this story. The horrors of the heathen religion under the rule of the Aztec priesthood are enough to make one's flesh creep. The book is rich in historical events and of thrilling interest from first to last.

A Little Handful. By Harriet J. Scripps.

This is a record of the sayings and doings of a little American boy whilst on a visit to this country. The quaint speeches and droll humour of the little fellow seem strangely unchildlike to our English ears. The story plainly shows that it is infinitely more important to bring out all the good in a child's character than to try to suppress the evil.

A Fair Claimant. A Story for Girls. By Frances Armstrong.

This story opens with the heroine's mother leaving home, where she lives unhappily with her husband, and taking Olive to London under an assumed name. One day the mother is run over in the street, and through a series of misadventures the father can never trace the little girl. Olive is adopted by a rich lady, taken abroad and educated. Eventually misfortune overtakes these kind friends, and then death; so that Olive must needs earn her own living. Chance brings her into her old home in England as a governess. Childhood's memories flit through her brain, and at last bring about her identification. It is a first-rate story, well written, and high in moral tone.

The Clever Miss Follett. By J. K. Denny.

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The Peep of Day.
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The Battle of the Rafts and other Stories of Boyhood in Norway. By H. H. Boyesen.
This pretty and substantial little volume contains a variety of stories, all good and suitable for either boys or girls.

The Children's Treasury for 1894 is not a whit behind its predecessors in wealth of pretty pictures and tales, whilst the outside, if anything, is brighter than ever.

Leaving the Manse. A Disruption Tale. By Kezia.
Fifty years ago the disruption in Scotland caused party spirit to run very high in the Church. This little history gives some account of the feeling at that time. So great a pass did things come to that some were even denied burial of their dead. A thoroughly interesting brochure.

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Evil May-Day (E. Everett Green).
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Up the Chimney to Ninny Land (Chester).
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PUBLICATIONS RECEIVED.

JARROLD AND SONS.
An Introduction to the Study of the French Verb.

UNIVERSITY CORRESPONDENCE COLLEGE PRESS.
Virgil: Æneid, Book III. (Allcroft & Mason).

MACMILLAN AND CO.
Westward Ho (Abridged).

G. PHILIP AND SONS.
Wood-work (Lessons in).
Physical Drill of all Nations (Alexander).

CAMBRIDGE UNIVERSITY PRESS.
Cambridge Companion to the Bible.
English Grammar (West).
A Midsummer Night's Dream (Verity).

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Musical Times.

REVIEWS.

The Cambridge Companion to the Bible. Cambridge: At the University Press.

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The Rev. H. E. Ryle, Hulsean Professor of Divinity, leads off with a paper on the Structure of the Bible, and a masterly account of the History of the Old and New Testament Canon, to which Bishop Westcott adds an Appendix on the sacred books of Præ-Christian Faiths. Sections on the Preservation and Translation of the Bible are contributed by Dr. Sinker and Dr. W. F. Moulton.

Special pains have been bestowed on a series of Introductions to, and Summaries of, the several books of the Bible. These are concise and yet full, and are written by Bishop Perowne, Professors Lumby, Davidson, and others. Bible History is also very thoroughly treated by Mr. Carr and several of the leading professors; and sections follow on Chronology and Antiquities.

Canon Bonney describes in his clear and interesting style the geography and geology of Bible lands, and the section on Natural History is completed by Mr. Houghton's notices of Animals and Plants.

A remarkably interesting glossary of Bible Words is supplied by Professor Skeat, and we believe no higher authority on English Philology could be secured.

The alphabetical indexes of proper names and subjects referred to in the Bible will be found very useful, as also the Concordance compiled by the Rev. M. F. Lord. A set of specially prepared maps, beautifully executed, accompanied by a list of Biblical names of places, with latitudes and longitudes, and inserted at the end of the book, cannot fail to be highly appreciated.

Altogether we can recommend the volume as one likely to prove eminently serviceable to teachers and to all students of Scripture.

The English Language: Its History and Structure. By W. H. Low, M.A. (Lond.) London: W. B. Clive.

This volume is one of the admirable series of students' books issued from the University Correspondence College Press. It is specially intended for candidates preparing for the Matriculation Examination of the London University, but it will be found equally well adapted for students preparing for other examinations of similar or somewhat wider range.

The author is remarkably clear in his statements, and gives a masterly explanation of Grimm's law, which plays so important a part in modern philology. The portions of the book dealing with derivation abound in examples of extreme interest.

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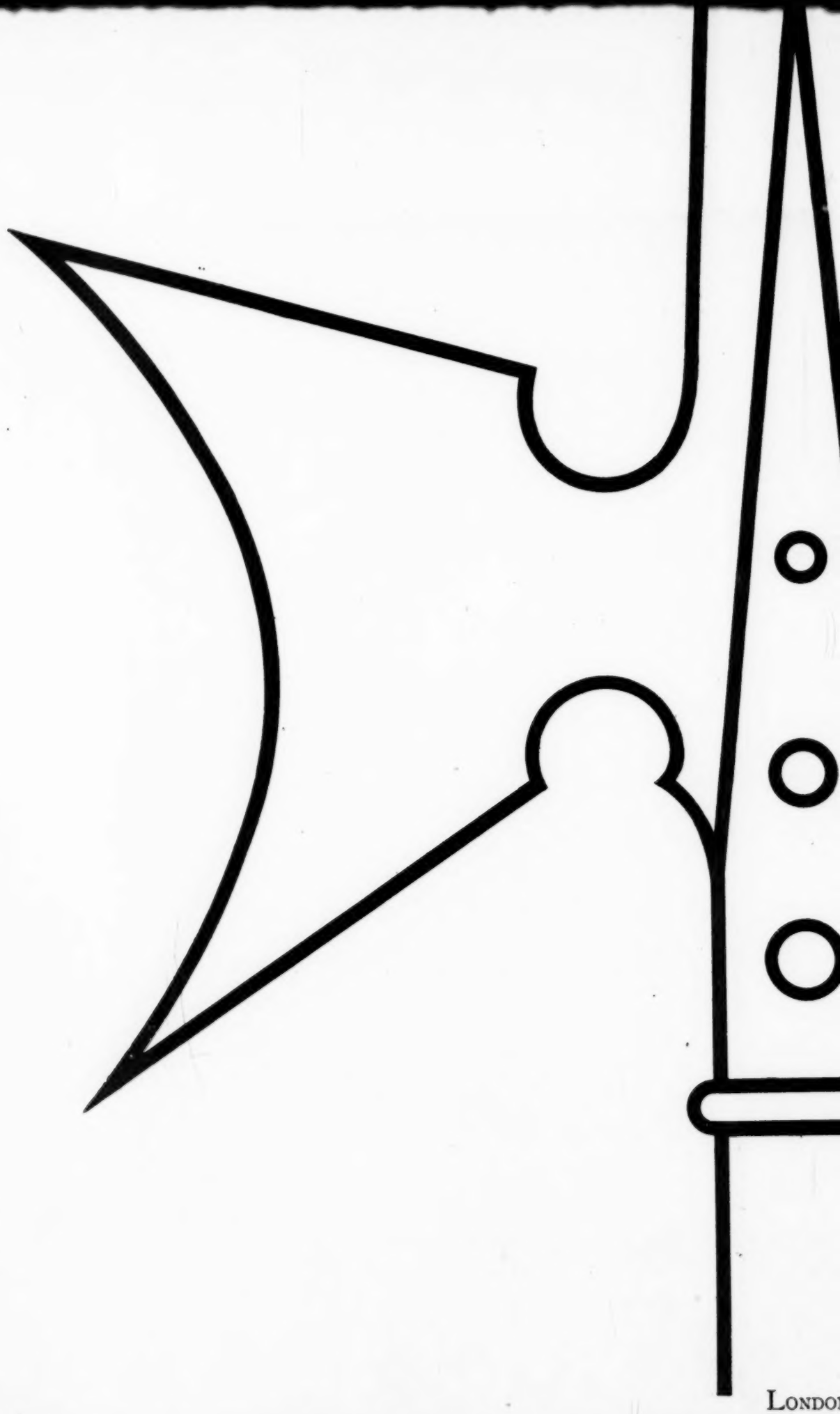

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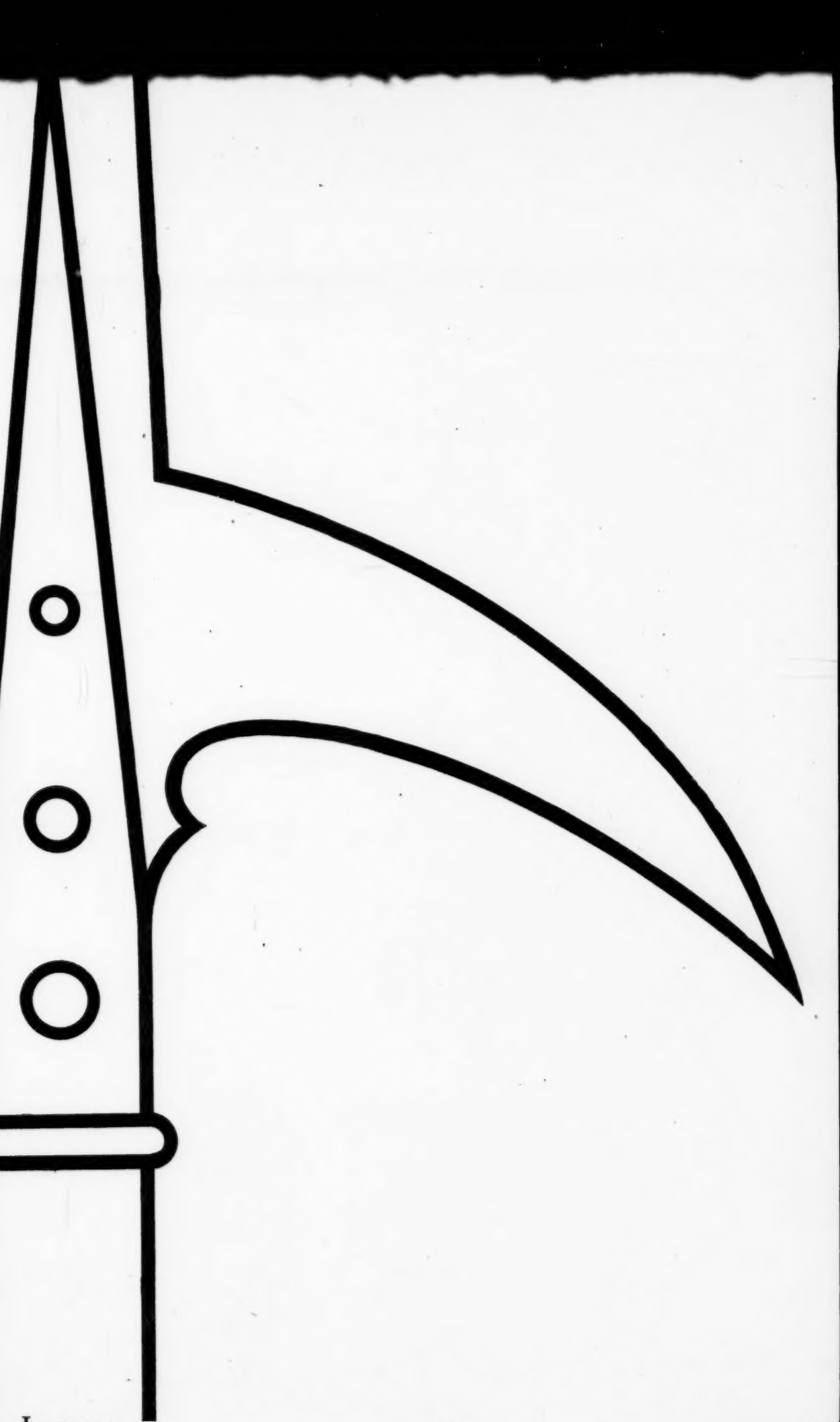

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